Institute of Freshwater Ecology

River Nar eutrophication studies
3. Diatoms

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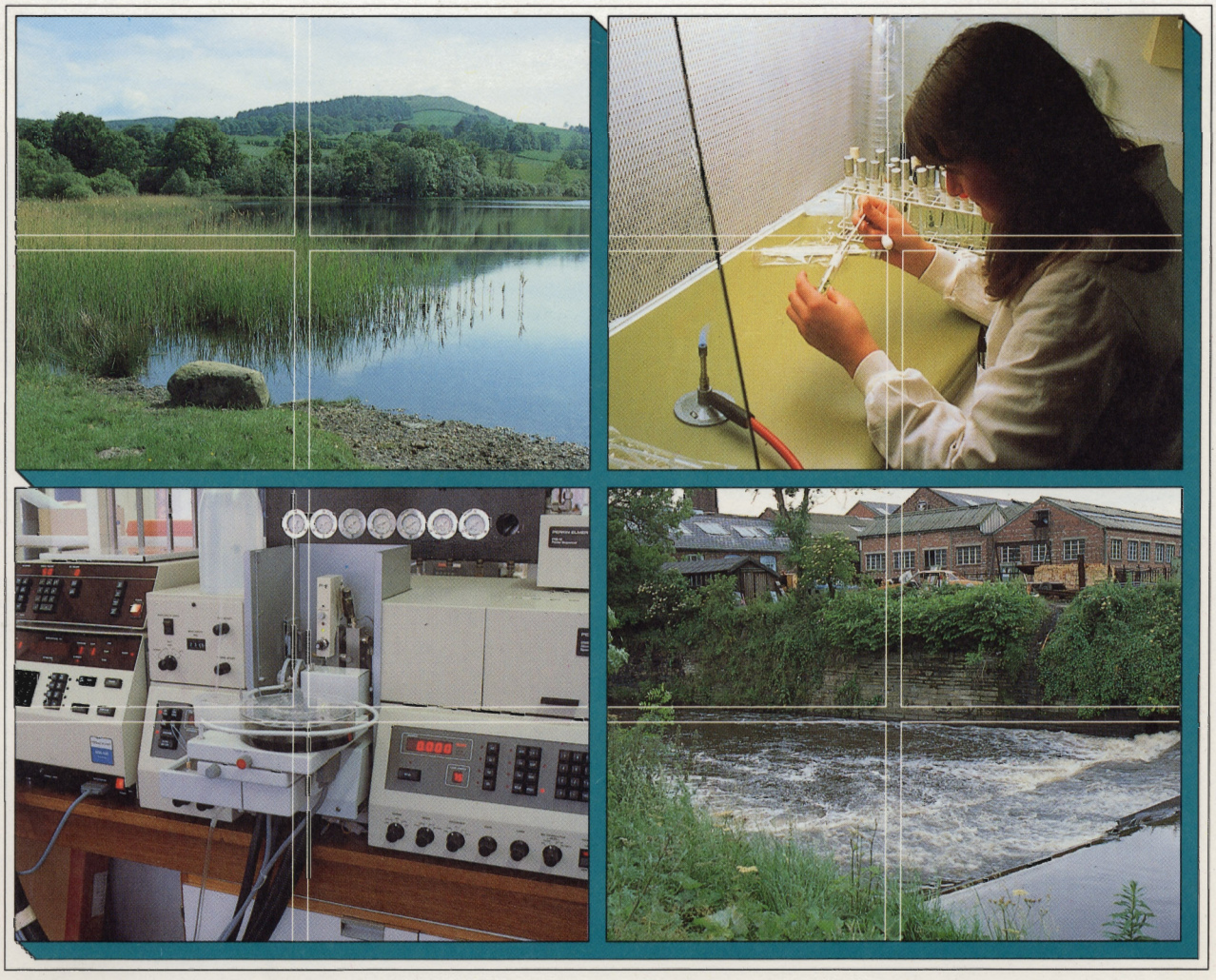

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Natural Environment Research Council

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Institute of Freshwater Ecology

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Anglian Region

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ACKNOWLEDGMENTS

Anglian NRA provided us with access to the sites on the River Nar. T. Clough provided us with valuable information at various points during the course of the contract. I am particularly grateful to Anne Binks who provided chemical data on the River Nar from the public register at very short notice.

The support of other members of staff of the Institute of Freshwater Ecology is gratefully acknowledged. To Dr E.Y. Haworth who gave valuable time and assistance over the identification of diatoms. And to J.A.B. Bass and A. Garbutt for support in the field and the laboratory.

EXECUTIVE SUMMARY

Constraints: The River was not surveyed during late summer when discharge would be at its lowest level, biological activity would have been greater and the impact of degraded imputs would be at a maximum. The sampling method (HMSO 1993) was not always suitable and at six sites epiphyton had to be sampled.

Most of the sites fitted into pollution category 3 HMSO (1993). This is indicative of an alkaline, enriched but not seriously polluted system. Since this method did not significantly separate the sites, several other methods were used. Many of them suggested that most of the upper catchment source waters were more stressed than the downstream sites, although nutrient concentrations were not higher. A few downstream sites (41 - 44) showed early signs of further degradation. The R. Nar is nutrient rich from the source (approximately 10 mg l^{-1} NO_3-N, about twice that of sources of chalk streams in Dorset) and this may reflect the dominance of *Achnanthes lanceolata* at these sources. Further downstream classic chalk-stream diatoms were observed characteristic of clean, although eutrophic, chalk streams, inspite of increasing phosphate concentrations and high nitrate levels. At several sites very large coatings of diatoms were found covering the gravel (frequently dominated by *Navicula avenacea*) and this is also typical of the diatom populations which grow in profusion during spring in chalk streams. Species reflecting the slow-flowing and canalised nature of many of the sites were found.

The presence of certain indicator species suggested that parts of the River Nar could degrade either during the summer or in the future. Sites to watch in the future, particularly in summer, are those close to effluents of sewage works in small streams (sites 4-5 and 22-23) and sites near fish farms (sites 24, 25, 28, 43 and 44).

KEYWORDS

River, periphyton, epilithon, epiphyton, eutrophication, pollution.

1. PROJECT DESCRIPTION

The Institute of Freshwater Ecology (IFE) accepted a contract with the NRA Anglian Region, to assess the diatoms of the River Nar in relation to eutrophication.

1.1 Contractual objectives

Sites: Up to 45 sites (20 main river, 25 tributary sites) to be sampled --- in fact 46 were listed.

Sampling methodology: In accordance with the current draft of the SCA "Use of epilithic diatoms to monitor water quality in rivers".

Field records: To include photographic record and sketch map of site.

Identification and enumeration: Taxa to be identified to levels appropriate for assessing water quality. Enumeration to be based on relative abundance.

Data storage: Information to be stored on paper records and disc.

Reporting: Results to be evaluated to determine the degree of eutrophication in the catchment. Recommendations to be made for monitoring in the years 1993/94 and 1994/95.

1.2 Background

The River Nar is a chalk stream in north-west Norfolk. Chalk streams have been studied very widely in southern England, particularly in Dorset by the Institute of Freshwater Ecology. One of the best descriptions of a chalk stream was that by Westlake et al. (1972). The algae have been more fully described by Marker (1976a and b) and in experimental systems (Marker and Casey 1982, Marker et al. 1987). In addition considerable information concerning the seasonal periodicity of chalk stream diatoms was gleaned from changes in the dissolved silica concentrations (Casey et al. 1982, Marker et al. 1984).

2. METHODS

2.1 Background

The methods used in this survey largely follow those recommended by HMSO 1993. At the time of writing this book was not in print. The only material available was a couple of early drafts, to which the author of this report had confidential access, and an initial galley proof which omitted several important photographs and references referred to in the text. The most important of these is a report by Descy and Coste (1990) to the Belgian Department of the Environment which had not been received at the time of writing. The other outlet for this information is a manual on periphyton methods edited by R.G. Wetzel which is still in preparation.

2.2 Site description

At all sites a small sketch plan was drawn and a short description of the site noted. This description included the dimensions of the stream, water depth, water clarity, water velocity, nature of the substratum, submerged and emergent macrophytes present and the extent of the canopy. Two photographs were taken at most sites, one a general view, the other directly into the water showing the nature of the substratum sampled. Only one set of slides has been deposited with the NRA with this report. No copy of the slides has been retained by the contractor.

2.3 Sampling of epilithic algae

The sampling method (HMSO, 1993) is quite explicit and is quoted below:

> *"Select a site where the water is flowing over stones (a riffle) which can be easily sampled, Where possible avoid disturbed sites (e.g. cattle drink) or where there is extensive macrophyte cover. Remove 5 small (up to 5-10 cm diameter) preferably flat stones from the river bed at a suitable site away from the bank and at a depth under e.g. 0.5m. Avoid stones covered with a coating of green algae or silt. Clearly it is not always possible to conform to this pattern and a degree of judgement has to be made at each site."*

The sites specified in this contract by the NRA were chosen for reasons not disclosed to the contractor who was faced with many sites which were not suitable for the method. The types of problem are listed below:

a) Many sites were slow-flowing and were largely covered in soft sediments. Stones were therefore taken from very restricted locations which were frequently either deeper than 0.5m, or near to the bank. Frequently no riffles were present. An admixture of the epipelic flora was therefore inevitable, even after preliminary washing.

b) Some sites had been disturbed by dredging or weed clearance.

c) At some sites, particularly those which may have been winterbournes, the only available substrata were underwater macrophytes.

d) Many sites were covered by a partial or complete tree canopy and this extensive shading makes interpretation more difficult and is not directly covered by the method. Indeed Professor Round (the author of HMSO 1993) comments that much more information is required on the effects of low light on the epilithic flora.

e) Sampling took place during the middle of February 1993. At a few sites there was already an extensive growth of spring diatoms (Marker 1976a) but at other sites which were more turbid or there was an extensive tree canopy, there was no growth on bear stones or the residual flora from the autumn. Comparisons between sites were therefore not easy.

f) Stones in the River Nar are flints, which is typical of chalk streams. They are very rarely flat which the method recommends,

2.4 Laboratory methods

2.4.1 Preparation of diatom frustules (from epilithon)

Excessive growth of epipelic diatoms were removed by washing and discarded. The true epilithic flora was then removed by brushing with a soft tooth brush. This material was then examined live under the microscope. The suspension was concentrated by centrifugation and the supernatant discarded. 2 ml of saturated solution of potassium permanganate solution was added to the pellet together with twice the volume of concentrated hydrochloric acid. This mixture was then dark brown in colour and during subsequent heating to 60° C for one hour the suspension turned yellow/light brown. The suspension was cooled, washed and centrifuged five times with distilled water until the acid and permanganate residues had been removed. The now cleaned diatom frustules were mounted in "Naphrax" diatom mountant.

2.4.2 Preparation of diatom frustules (from epiphyton)

The mild oxidation detailed in 2.4.1 was not suitable for closely adhering epiphytic diatoms (like *Cocconeis*) and the more rigorous treatment using chromic acid and hydrogen peroxide was employed. The cleaned frustules were washed, centrifuged and mounted in the same way.

2.4.3 Microscopy

Approximately 200 frustules were counted from each site in accordance with the method of HMSO (1993), using an oil-immersion objective. Diatoms were identified according to Hustedt (1930) and Krammer and Lange-Bertalot (1986, 1988, 1991).

2.4.4 Analysis

HMSO (1993) gives a general review of several indices for estimating the degree of

pollution/eutrophication. The paper also develops its own categories listed from 1 to 5. However the method does not give for any numerical analysis and the five categories are derived from small species lists. For reasons which will become apparent in the results section this has led to difficulties and several other methods have been used in addition:

(i) Descy (1979) uses a calculation depending on the abundance, the sensitivity and the indicator value of each species. In this survey most of the abundant species have a low indicator value and this leads to unrealistically high values. The calculation was not used. Instead the median sensitivity value was used on its own. Values range from one to five.

(ii) Descy and Coste (1990). This is the more up to date version and comprises a grid. G1 - G8 represents clean water to polluted water, while SG1 - SG4 represents "four subgroups of species of more euryoecious nature, i.e. having a wide tolerance, but broadly representative of clean acidic or alkaline waters (SG1), through increasing alkalinity/mineralisation to the (SG4) group which occurs in slightly saline waters" (HMSO 1993). Because chalk streams are nutrient rich from their sources, have high alkalinity and may become polluted downstream, the author of this report thought it would be much more valuable to quote average G and SG values for each site rather than a composite index.

(iii) Lange-Bertalot (1979). This index is quoted as well, but is based on a relatively simple pollution series. There are five main categories with groups 2 and 3 sub-divided (1, 2a, 2b, 3a, 3b, 4 & 5).

(iv) Watanabe (1986, 1988). This is based on a very extensive series of papers but operates from a highly polluted stand point with very few species in the truly saproxenic group. Since the R Nar appears to be poorly represented by Watanabe's saprophilous group, it is not possible to calculate a realistic DAIpo index. Instead, the dominant category is given. In our analysis only the Saproxenic (Xen) and Eurysaprobic (Eur) taxa were present.

(v) HMSO (1993) Each site will be categorised in accordance with the five listed goups (1 - 5). In addition the author will discuss this in relation to (i) - (iv) above and his own extensive experience of the Dorset chalk streams

The way these numerical categories has developed is confusing, since they progress in different directions! In each subsequent site description an arrow is used to indicate the direction of increasing pollution. Hence for Descy (1979) and Lange-Bertalot (1979) **1** is polluted and **5** is clean. For Descy and Coste (1990) and HMSO (1993) **1** is clean and **5** is polluted!

3. RESULTS

3.1 Background

Chalk streams have characteristically high alkalinity and are nutrient-rich from their sources, fed from large underground aquifers. They have been extensively described elsewhere (Westlake et al. 1972, Marker 1976a). These streams have a benthic diatom maximum in the spring which corresponds to a decline in the dissolved silica concentration in the stream water (Casey et al. 1981, Marker et al. 1984). Invertebrate grazing of these populations appears to be extensive so that diatoms do not persist extensively into the summer (Marker and Casey 1982, Marker et al. 1987). In the summer a characteristic population of algae, which lays down crusts of calcium carbonate, occurs, dominated by Chlorophyceae (*Gongrosira incrustans* Schmidle) and Cyanobacteria (*Phormidium incrustatum* (Näg) Gom. and *Homoeothrix varians* Geitler).

The River Nar is a chalk stream arising in Norfolk and flowing roughly west to join the tidal Great Ouse at King's Lynn. Even in February many of the populations described in Dorset streams were present in the R. Nar. Early examples of the spring diatom outburst occurred at sites 6, 7, 8, 10, 11, 12 and 17; elsewhere there was a close canopy or the water was deeper and the populations had not developed. Lime-encrusted populations, with their characteristic diatom associates, were also present at many sites.

A number of sampling problems were encountered which made the application of the designated method (HMSO 1993) difficult and in a few cases impossible. The method recommends the removal of five stones, covered with a thin layer of diatoms, from a riffle in open water approximately 30 - 50 cm deep. Of the 46 sites on the R. Nar:

1. 21 were satisfactory ----- adequate gravel, <75% tree canopy and flowing, shallow water.
2. 10 were very slow flowing.
3. 14 were excessively silty and this is bound to have contaminated the epilithon, even after preliminary laboratory washing.
4. 9 sites had a fully enclosed canopy and a further 6 sites had a 75% canopy.
5. At 6 sites only epiphytic algae could be sampled and this was considered preferable to taking no sample at all.

Diatoms of particular importance were *Achnanthes lanceolata, A. minutissima, Amphora pediculus, Cocconeis placentula* var. *euglypta, Fragilaria construens, Gomphonema angustatum, Melosira varians, Navicula avenacea* (*N. lanceolata* in HMSO 1993), *N. gregaria.* Frequently one of these dominated a particular site and it largely determined the saprobic character of that site. Small populations of *Amphora veneta* and *Navicula veneta* sometimes occurred, indicating a gradual deterioration of the quality of the water.

In the analysis of the results three problems immediately became apparent and this made the author broaden the investigation:

1. It was clear that the R. Nar was eutrophic from its source and that there were no

severe cases of pollution downstream, although there a few signs of degradation. Of the five saprobic categories listed in HMSO (1993), virtually all fitted into the middle group (3). If *Achnanthes minutissima* is deemed to straddle groups 2 and 3 then some sites are 2/3 but I believe then to be essentially group 3. None fitted groups 1 or 2 in the true sense; The lack of *Meridion circulare* from the springs essentially eliminates the presence of category 2.

2. Most of these source waters were dominated by *Achnanthes lanceolata* which is very unfortunate since this species is not listed by HMSO (1993). Other workers list this species as more pollution tolerant than the species occurring lower downstream in the Nar; in this report we have treated *A. lanceolata* in this way rather than ignore it. It may well be that *A. lanceolata* is responding to the very high nitrate concentrations of the source waters and that other synagistic factors are mitigating its effect downstream.

3. Many of the sites had an extensive covering of sand and soft sediments. It was, therefore, impossible always to select populations which were not partially contaminated by epipelon (*Gyrosigma* and *Navicula*). Many sites were slow flowing and contained large populations of *Melosira* and *Fragilaria.* Related to this we disagree in one detail with HMSO 1993; the spring population of diatoms in chalk streams grows thickly on any surface, including stones and includes *N. avenacea* (*N. lanceolata*). Under these circumstances it is inaccurate to describe this species as an epipelic contaminant, since it grows profusely on all surfaces.

3.2 Individual Sites

3.2.1 Site 1, TF906188 (R. Nar, most upstream site --- a source)

The site indicated on the map is a canalised stream, possibly a winterbourne. The channel bed was covered in grass and there were no stones. The epiphytic flora was not samples but a small area by the road bridge was chosen where a small gravel area was found.

Site description (as indicated on map)

Stream width	2 m
Depth	0.25 m
Water velocity	medium
Water clarity	clear
Macrophyte cover	100% grass
Canopy	none

Site description (sample location)

Stream width	2 - 8 m
Depth	0.14 m
Water velocity	medium
Water clarity	clear
Substratum	<5% gravel; 95% macrophytes comprising *Veronica* spp., *Mentha aquatica*, *Callitriche* sp.
Bank	50% canopy of *Fraxinus*, tall thistles and teasles on both sides.
Land use	Fenced off horse paddock.
Sample location	near bank, in medium flowing water.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	63.4
minutissima	7.0
Meridion circulare	9.8

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G3 SG3	→
5.	HMSO (1993)	(3)	→

Comment

The diatoms were a thin covering on clean flints. The presence of *A. lanceolata* increases eutrophic/pollution status (or saprobic valency) of this and other sites in the upper reaches of the R. Nar near the sources (authors 1,2 and 4 above).

3.2.2 Site 2, TF903179 Small side tributary

Site description

Scrub had been cleared in and around the wood (east side) and the stream appeared to have been cleared

Stream width	0.6 m
Depth	0.05 m
Water velocity	fast
Water clarity	clear
Substratum	clean gravel 100%;
Bank	50% canopy cover; oak and alder scrub on west bank, bare earth on east bank
Land use	woodland
Sample location	sample taken from riffle in clean gravel

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	84.7
Meridion circulare	7.3

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G3 SG3	→
5.	HMSO (1993)	(3)	→

Comment

The diatoms were growing on clean flints. See site 1 for comments on the diatoms.

3.2.3 Site 3, TF893179 R. Nar

Site description

Stream width	4 m
Depth	0.24 m
Water velocity	fast
Water clarity	clear
Substratum	isolated pieces of gravel, over fine sediment between 85% macrophyte cover: *Veronica* sp., *Apium nodiflorum*, *Rorippa nasturtium-aquaticum*, *Callitriche* sp. and emergent grass.
Bank	Open canopy. Grassy banks with occasional alder
Land use	grazed meadows
Sample location	samples taken from an open area of gravel, kept clear of weed by the fast flow of the stream.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	63.2
Gomphonema angustatum	16.5
Meridion circulare	7.8

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G3 SG3	→
5.	HMSO (1993)	(3)	→

Comment

The diatoms were growing on clean flints. Some small lumps of *Chaetophora* sp. were observed in the sample. See site 1 for comments on the diatoms.

3.2.4 Site 4, TF891172 Small side tributary

Site description

Blocks of soil in the channel. Grass and nettles growing into the channel, suggesting that the stream may have been partially dry earlier.

Stream width	1.5 m
Depth	0.17 m
Water velocity	fast
Water clarity	clear
Substratum	35% gravel, 60% soft sediment, 5% *Epilobium*
Bank	75% canopy; privet, hawthorn, as, willow on the west bank; nettles etc on the east bank.
Land use	Wooded west bank, grazed fields east bank
Sample location	samples taken in riffle

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	27.7
lauenbergiana	10.3
Amphora pediculus	28.5
Navicula gregaria	5.9

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	2a/3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG3	→
5.	HMSO (1993)	3	→

Comment

Clean flints. Note the decreasing importance of *Achnanthes lanceolata* and the increasing importance of *A. minutissima* apparently leads to a marginally improved status (see 1, 2 and 4 above)/

3.2.5 Site 5, TF891174 Small side tributary, just below site 4.

Sample site was 200 m down stream of sewage works

Site description

Stream width	1 m
Depth	0.1 - 0.25 m (due to bankside collapse)
Water velocity	medium
Water clarity	clear
Substratum	30% small stones overlying fine sediment; 70% detritus. Occasional plants of *Epilobium*, *Apium* and emergent grass.
Bank	Open site; Grass; Alder scrub set well back from east bank.
Land use	grazed fields
Sample location	stones had to be taken from a wide area as the bank had collapsed covering the stream bed with soil.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	37.9
lauenbergiana	10.6
Gomphonema angustatum	11.0
Navicula gregaria	7.6

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G3 SG3	→
5.	HMSO (1993)	3	→

Comment

Clean but very small flints. *A. lanceolata* still dominates the flora as is reflected in the saprobic status. This site is just below a small sewage works and the presence of small, but significant, percentage of *Navicula muralis* occurred; not enough to significantly affect the saprobic status but the site is worth watching in August or September when base-line river flows occur.

3.2.6 Site 6, TF889174 R. Nar

Site description

Stream width	2 m
Depth	0.15 m
Water velocity	fast
Water clarity	clear
Substratum	85% gravel and stones; 15% silt; <5% *Veronica* and *Callitriche.*
Bank	at least 75% canopy cover; north bank, a private garden; south bank, scrub.
Land use	north, private garden; south, overgrown scrub.
Sample location	samples taken mid-stream, in a riffle.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	8.0
lauenbergiana	10.2
Amphora pediculus	6.2
Gomphonema angustatum	7.1
Navicula gregaria	24.3
minima	8.0
Rhoicosphenia curvata	5.8
Synedra ulna	5.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G3 SG3	→
5.	HMSO (1993)	3	→

Comment

Flints covered in mud which was not easily washed off. There was some contamination of the true epilithon.

3.2.7 Site 7, TF886173 R. Nar

Site description

Stream width	2.5 m
Depth	0.1 - 0.15 m
Water velocity	fast
Water clarity	clear
Substratum	45% gravel, 40% sand, 10% dead leaves, 5% *Apium nodiflorum*, *Veronica anagallis-aquatica* and *Rumex hydrolapathum*.
Bank	Closed canopy; north bank, young willow; south bank, young will and hawthorn.
Land use	north, grazed field; south, predominantly beech woodland.
Sample location	taken in riffle.

Empty shells of *Anodonta* sp. found in the channel.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	10.7
Amphora pediculus	5.3
Gomphonema angustatum	13.3
Navicula avenacea	17.3
gregaria	12.4
minima	6.2
Surirella ovata	5.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G3/4 SG3	→
5.	HMSO (1993)	3	→

Comments by the author of the report

A thick covering of diatoms with associated silt, contaminating the sample inspite of preliminary washing. At this and site 6, only Descy indicates an improving status.

3.2.8 Site 8, TF869168 R. Nar

There was much wood and debris in the channel. The main flow goes through a drain to a bypass channel for the lake. Adjacent fields had recently been sprayed with fertilizers.

Site description

Stream width	2.5 m
Depth	0.3 m
Water velocity	slow
Water clarity	clear
Substratum	70% sand and gravel; 30% fine sediment; no macrophytes.
Bank	50% canopy; north bank, alder scrub; south bank, grass.
Land use	woodland and grazed pasture.
Sample location	site highly modified to provide water for ornamental lakes. Sample taken from best available place.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	10.1
lauenbergiana	14.5
Amphora pediculus	25.6
Fragilaria construens	31.3

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comment

A very thick covering of diatoms with associated silt, inevitably contaminating the sample inspite of preliminary washing. The status is apparently improving due to decreasing proportions of *Achnanthes lanceolata* and increasing *Amphora pediculus*.

3.2.9 Site 9, TF869171 Small side tributary

Water flows over a weir into a shallow pool (also a pool upstream of weir)

Site description

Stream width	10 m
Depth	0.15 m
Water velocity	fast over the weir but stagnant in the shallow lake
Water clarity	clear
Substratum	100% soft sediment; no gravel or stones visible.
Bank	75% canopy cover; both banks grassed.
Land use	conifers planted for ornamental purposes around weir surrounding open fields.
Sample location	Sample was one piece of mortar taken from the sill of the weir. There was also terrestrial vegetation on the sill, suggesting that there was no flow until recently.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	19.2
minutissima	5.1
Fragilaria construens	20.9
Gomphonema angustatum	7.9
Melosira varians	11.3

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3	←
2.	Lange-Bertalot (1979)	2a/3b	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G3 SG3	→
5.	HMSO (1993)	3	→

Comment

A. lanceolata at 19% represents an apparently intermediate status.

3.2.10 Site 10, TF859169 R.Nar

Site description

Stream width	2 m
Depth	0.2 m
Water velocity	slow
Water clarity	clear
Substratum	70% gravel, 20% dead leaves and silt; 10% encroaching marginal vegetation of *Veronica* and *Epilobium*.
Bank	50% canopy due to very steep, high banks (3 m). *Urtica* on bank.
Land use	grazed fields
Sample location	Gravel overlayed with *Cladophora* and silt. Sample taken upstream of the bridge rather than at the marked site ---- unsuitable for sampling.

Two empty *Anodonta* shells found and one live specimen.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	6.1
lauenbergiana	5.3
Amphora pediculus	11.8
Fragilaria construens	17.9
Navicula avenacea	30.0
gregaria	6.1
Synedra ulna	6.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	2a/3b	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comments by the author of the report

A very thick covering of diatoms with associated silt, inevitably contaminating the sample inspite of preliminary washing. The *Fragilaria construens* is an inevitable consequence of the slow flowing site.

3.2.11 Site 11, TF839168 small side tributary

Site description

Stream width	1 m
Depth	0.11 m
Water velocity	medium
Water clarity	clear
Substratum	isolated patches of gravel over silt. *Glyceria fluitans* encroaching over the channel.
Bank	open canopy; grass
Land use	grazed fields
Sample location	stream runs through a drain under the road upstream (ponded on the other side); channel clogged with *Glyceria*; sample taken from an exposed area of the bed.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	32.3
minutissima	8.2
Gomphonema angustatum	16.8
Meridion circulare	11.1
Navicula minima	6.1
veneta	9.3

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G3 SG3	→
5.	HMSO (1993)	(3)	→

Comment

A very thick covering of diatoms with associated silt, inevitably contaminating the sample inspite of preliminary washing. Another source site but this time there was a significant *Meridion* population (>10%).

3.2.12 Site 12, TF838169 R. Nar

Site description

Stream width	2.5 m
Depth	0.14 m (sample site), 0.24 m average
Water velocity	medium
Water clarity	clear
Substratum	40% sand, 40% gravel/sand, 20% marginal silt; occasional marginal plants of *Apium. Berula, Glyceria maxima, Phalaris arundinacea, Veronica anagallis-aquatica, Rorippa nasturtium-aquaticum.*
Bank	Open canopy; bank of grass.
Land use	grazed fields
Sample location	sample taken in a riffle towards the edge of the channel.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	6.2
Fragilaria capucina	10.0
Gomphonema angustatum	5.7
olivaceum	5.3
Navicula avenacea	44.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG3	→
5.	HMSO (1993)	(3)	→

Comments by the author of the report

A very thick covering of diatoms with associated silt, inevitably contaminating the sample inspite of preliminary washing. Lange-Bertalot gives a lower pollution status due to *N. avenacea.* Other authors treat this species differently.

3.2.13 Site 13, TF832163 R. Nar

Site description

Stream width	6 m
Depth	0.15 m
Water velocity	fast
Water clarity	clear
Substratum	95% coarse gravel, 5% sand; isolated plants of *Veronica anagallis-aquatica, Epilobium, Carex, Mentha aquatica* and short lengths of *Cladophora.* Heavily grazed by geese and ducks.
Bank	open canopy; north bank: *Epilobium, Phalaris, Carex and Scrophularia*; south bank of grass.
Land use	mown lawns
Sample location	sample taken mid-stream in a riffle.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	7.9
minutissima	46.6
Amphora pediculus	22.4
Gomphonema olivaceum	5.2

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1 SG2	→
5.	HMSO (1993)	3	→

Comments by the author of the report

Large flints with a thinner covering of diatoms covering a classic lime-encrusting community (see site 15 below). The sample contained a large amount of *Chantransia* (a red alga). This diatom population is typical of chalk streams before and after the spring bloom of diatoms (see site 15 for a full description).

3.2.14 Site 14, TF825154 small side tributary

Site description

Stream width	1m
Depth	unknown
Water velocity	no flow detected
Water clarity	clear
Substratum	thick layer of soft sediments, no stones visible
Bank	open canopy; grassy banks
Land use	rough pasture
Sample location	marginal emergent grass sampled for epiphytes

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata 78.7

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G3 SG3	→
5.	HMSO (1993)	(3)	→

Comments by the author of the report

One of several sites where **NO** epilithon was available. Note that *A. lanceolata* exists in the epiphyton as well as the epilithon.

3.2.15 Site 15, TF828153 R. Nar

Site description

Stream width	6 m
Depth	0.13 m
Water velocity	fast flow on east bank, slow flow west bank
Water clarity	clear
Substratum	80% gravel, 20% sand; individual plants of *Ranunculus penicillatus* var. *calcareus, Apium modiflorum, Veronica* sp., Upstream of the bridge 30% of the stream bed was covered in *Ranunculus penicillatus* var. *calcareus.*
Bank	50% canopy cover; east bank, overhanging hawthorn, alder and ash; west bank, overhanging willowherb.
Land use	rough pasture and a wooded area (carr)
Sample location	sample taken towards the east bank (fast flow); very stable stream bed covered in lime encrusted flints.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	8.6
minutissima	10.1
Amphora pediculus	19.8
Fragilaria capucina	18.3
Navicula gregaria	11.2
veneta	9.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	5	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG3	→
5.	HMSO (1993)	3	→

Comments by the author of the report

These flints had fewer diatoms than sites 7, 8, 10, 11 and 12. There was a thick lime-encrusted flora comprising:

Phormidium incrustatum
Homoeothrix varians
Gongrosira incrustans
Chantransia

see Marker (1976) and Marker and Casey (1982) for details.

The diatoms are typical of an encrusted epilithon in chalk streams.

3.2.16 Site 16, TF823151 R. Nar

Site description

Stream width	5 m
Depth	0.4 m
Water velocity	moderate
Water clarity	clear
Substratum	78% compacted silt, 2% gravel, 20% emergent macrophytes --- *Epilobium,Juncus, Phalaris, Veronica, Rorippa.*
Bank	open canopy; north bank, scrub; south bank, *Phragmites, Phalaris.*
Land use	south, reed beds; north, abandoned water meadow.
Sample location	eroded banks with lumps of soil on the stream bed; dead *Phalaris* stumps causing silting up; stones taken where available.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	8.8
minutissima	17.6
Amphora pediculus	14.6
Cocconeis placentula var. *euglypta*	12.1
Gomphonema angustatum	13.0
Navicula veneta	7.9

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1/2 SG3	→
5.	HMSO (1993)	2/3	→

Comments by the author of the report

Thin covering of diatoms on flints. Note that in Lange-Bertalot's classification the dominance of *A. minutissima, A. pediculus, C. placentula* and *G. angustatum* gives G1/2 (clean water) but a high subgroup value (SG3 --- high alkalinity), typical of chalk streams.

3.2.17 Site 17, TF819148 R. Nar

Site description

Stream width	9 m
Depth	0.15 m
Water velocity	fast
Water clarity	clear
Substratum	80% gravel (thick with diatoms), 5% sand, 15% macrophytes (*Veronica, Rorippa, Callitriche*)
Bank	open canopy; grass
Land use	grazed rough pasture
Sample location	sample taken in riffle

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes minutissima	43.5
Amphora pediculus	23.2
Gomphonema angustatum	5.1
Navicula gregaria	9.7

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1 SG3	→
5.	HMSO (1993)	3	→

Comments by the author of the report

A thick covering of diatoms superimposed on a lime-encrusted population. Hence most of the diatoms were no where near the flint surface. Compare with sites 12, 13 15 and 16.

3.2.18 Site 18, TF818145 small side tributary

Site description

Stream width	3 m
Depth	0.25 m
Water velocity	slow
Water clarity	clear
Substratum	5% silt (very little gravel); macrophytes --- 70% *Rorippa*, 10% *Juncus*, 15% *Veronica, Apium, Callitriche.*
Bank	open canopy; grass banks
Land use	grazed pasture
Sample location	95% of stream bed clogged with weeds; very difficult to find suitable sample.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	7.5
minutissima	19.5
Amphora pediculus	13.0
Fragilaria capucina	8.5
construens	6.0
pinnata	26.5

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG3	→
5.	HMSO (1993)	3	→

Comment

Flints covered with a lime-encrusted population comprising largely *Gongrosira.* For comments see site 15.

3.2.19 Site 19, TF816146 R. Nar

Site description

Stream width	8 m
Depth	0.15 m
Water velocity	medium
Water clarity	clear
Substratum	100% gravel; downstream of the ford, 20% *Ranunculus, Callitriche* cover
Bank	Full canopy of oak and alder
Land use	woodland
Sample location	samples taken upstream of the ford (indicated on the map) to avoid possible disturbance.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	11.9
minutissima	46.3
Amphora pediculus	14.7
Fragilaria construens	8.7

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1 SG3	→
5.	HMSO (1993)	3	→

Comment

Flints covered with a lime-encrusted population comprising *Gongrosira, Phormidium* and *Chantransia.* For comments see site 16.

3.2.20 Site 20, TF807152 R. Nar

Site description

Stream width	5 m
Depth	0.45 m
Water velocity	medium in main channel but slow either side
Water clarity	clear
Substratum	50% gravel, 25% silt, 25% macrophytes (*Hippuris, Apium, Glyceria, Rorippa*)
Bank	open canopy; scrub --- willow alder reeds
Land use	marshy scrub
Sample location	samples taken with great difficulty in the main flow; large sandy beds.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	6.5
minutissima	14.6
Cocconeis placentula var. *euglypta*	62.8

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Xen	
4.	Coste and Descy (1990)	G1 SG3	→
5.	HMSO (1993)	3	→

Comment

Very clean flints --- only a thin population of diatoms. An improving saprobic status which clearly shows the use of 4. (Coste & Descy) The Group value is low, indicating no pollution but SG3 indicates high alkalinity and nutrients.

3.2.21 Site 21, TF789151 R. Nar

Site description

Channel upstream of ford recently dredged and a passage cut out of the sand banks through *Glyceria.* River bed 100% sand and impossible for sampling away from the ford.

Stream width	2 m
Depth	0.3 m
Water velocity	medium
Water clarity	clear
Substratum	100% gravel; a few individual plants of *Rorippa nasturtium-aquaticum*
Bank	75% canopy; bank, marshy scrub
Land use	woodland
Sample location	samples taken from edge of ford, upstream

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	9.3
lauenbergiana	12.1
minutissima	23.7
Amphora pediculus	24.5
Navicula minima	6.2

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4/5	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1/2 SG2/3	→
5.	HMSO (1993)	3	→

Comment

These flints contained a thick covering of the lime-encrusted algae and was about 90% *Gongrosira* with lesser amounts of *Phormidium.* See site 15 for comment.

3.2.22 Site 22, TF779147 R. Nar

Site description

Upstream the channel has been dredged recently. The margins of the stream were sandy but elsewhere *Ranunculus* occurred in larger proportions.

Stream width	7 m
Depth	0.2 m
Water velocity	fast
Water clarity	clear
Substratum	80% gravel, 20% sand/silt; individual plants of *Epilobium, Rorippa, Ranunculus*
Bank	closed canopy; north bank, willow and alder; south bank, grass
Land use	woodland/private garden
Sample location	mid-stream in riffle

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	10.1
Amphora pediculus	45.6
Fragilaria pinnata	8.8
Navicula gracilis	5.1

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	5	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG3	→
5.	HMSO (1993)	3	→

Comments by the author of the report

There was a large lime-encrusted population as per site 21. See site 16 for comments.

3.2.23 Site 23, TF771146 R. Nar

Site description

Stream width	8 m
Depth	0.25 m (0.5 m at the deepest point)
Water velocity	medium
Water clarity	clear
Substratum	80% gravel, 20% soft sediments, individual plants of *Rorippa nasturtium-aquaticum*
Bank	closed canopy; willow, alder
Land use	willow, alder carr
Sample location	samples taken towards the edge of the stream in shallow water.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	8.0
minutissima	46.0
Amphora pediculus	7.6
Fragilaria construens	6.5

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1 SG2	→
5.	HMSO (1993)	2/3	→

Comments

There was a leathery crust of *Chantransia* covering large flints. Another mid-stream eutrophic site.

3.2.24 Site 24, TF767146 small side tributary (after fish farm)

Site description

Access appeared to be impossible to the site indicated on the map, except through a private estate. Time did not allow for the usual channels for permission to be explored. Instead, access was through the fish farm and the site chosen was as far down the exit channels from the fish farm as possible.

Stream width	1.5 m
Depth	0.15 m
Water velocity	fast
Water clarity	clear
Substratum	70% gravel (kept clear by the fish farm), 30% sand and silt associated with the margins. Emergent grass and reed at the margins. *Cladophora* beginning to grow on the stones.
Bank	open canopy
Land use	mown grass surrounding fish ponds
Sample location	sample taken from the main exit channel

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Amphora pediculus	10.5
Cocconeis placentula var. *euglypta*	6.0
Fragilaria construens	34.8
Navicula gracilis	7.5

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a/3b	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comment

Another very thick lime crust on large flints containing *Phormidium* and *Gongrosira.* A mid-stream eutrophic site.

3.2.25 Site 25, TF765144 R. Nar

Site description

Stream width	8 m
Depth	0.25 m
Water velocity	medium
Water clarity	clear
Substratum	70% sand, 30% fine gravel
Bank	closed canopy, alder
Land use	swamp, alder carr woodland
Sample location	sample taken in shallow water near the bank where a few stones were larger.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	11.3
minutissima	6.6
Amphora pediculus	46.5
Fragilaria construens	12.2

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	5	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comment

Very thin population of diatoms. The very clean status shown by Descy is due to his classification of *Amphora pediculus*, mot matched by the other authors.

3.2.26 Site 26, TF751137 R. Nar

Site description

Stream width	8 m
Depth	0.33 m
Water velocity	medium
Water clarity	clear
Substratum	60% gravel in soft sediment, 20 % silt debris in margins, 15% *Callitriche*, 5% *Ranunculus*. A significant amount of *Vaucheria*.
Bank	75% canopy; north bank, *Epilobium*; south bank, thick grasses, willow and alder scrub.
Land use	mixed woodland
Sample location	stream centre

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	6.8
Amphora pediculus	7.4
Cocconeis placentula var. *euglypta*	13.0
Fragilaria capucina	9.3
construens	17.9
pinnata	12.3
Melosira varians	5.0
Navicula minima	5.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Xen/Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	(3)	→

Comment

There were very few diatoms and there was inevitable contamination with silt.

3.2.27 Site 27, TF746134 R. Nar

Site description

Stream width	3.5 m
Depth	0.36 m
Water velocity	fast
Water clarity	clear
Substratum	70% gravel; 10% *Veronica, Rorippa*; 20% *Ranunculus*
Bank	75% canopy; brambles, nettles, *Epilobium* over stone embankment
Land use	channel runs between two tall buildings with 3m wide stretch of derelict land separating channel and buildings.
Sample location	turbulent

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	6.3
minutissima	14.3
Amphora pediculus	35.4
Navicula minima	10.1

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	5	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2/3	→
5.	HMSO (1993)	3	→

Comment

A thick lime-encrusted population --- see site 15 for a description.

3.2.28 Site 28, TF747132 R. Nar (after fish farm)

Site description

Stream width	8 m
Depth	0.22 m
Water velocity	fast
Water clarity	clear
Substratum	50% gravel, 20% *Ranunculus*, 30% *Cladophora*, occasional plants of *Rorippa.*
Bank	50% canopy; a line of trees (ash, sycamore and horse chestnut) provided the canopy; grassed banks
Land use	grazed fields
Sample location	samples taken in riffle

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	5.3
minutissima	10.8
Amphora pediculus	22.6
Cocconeis placentula var. *euglypta*	5.0
construens	14.8

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comments by the author of the report

Only 5% of the surface area of the flints was covered in lime crusts. *Chantransia* present.

3.2.29 Site 29, TF738134 small side tributary

Site description

A particularly difficult site. A small stream flowed under the road through a culvert. On the one side the stream was in a relatively deep ravine covered by a thick canopy. Access was blocked by fencing as well as the deep steep sides. Moreover the bottom was covered in soft sediments. On the other side of the road the stream flowed slowly close and parallel to the hedge along the road. This part of the stream was covered completely with macrophytes. At the road the water collected in a masonry well-like structure before flowing under the bridge.

Stream width	2.5 m
Depth	0.5 m
Water velocity	slow
Water clarity	clear
Substratum	20% soft sediment, 80% *Apium* and *Ranunculus*
Bank	50% canopy, grass verges
Land use	grazed field on west bank, hedge and road on east bank
Sample location	1) mud sample from walls of well container, 2) epiphytes from *Apium*, 3) epiphytes from *Ranunculus*

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

	29a	29b	29c
Achnanthes lanceolata	3.4	10.1	6.6
minutissima	31.2	9.0	9.2
Amphora pediculus	0	6.5	4.4
Cocconeis placentula var. *euglypta*	8.0	69.8	53.9
Navicula gracilis	6.8	0	4.4
Nitzschia dissipata	10.1	0	0

Pollution/Eutrophication status

		29a	29b	29c	saprobic direction 1 - 5
1.	Descy (1979)	4	4	4	←
2.	Lange-Bertalot (1979)	3a	3a	3a	←
3.	Watanabe et al. (1986)	Eur	Xen	Xen	
4.	Coste and Descy (1990)	G1 SG2	G3 SG2	G1/3 SG2	→
5.	HMSO (1993)	2/3	3	3	→

Comment

This was a particularly difficult site. There was a deep sandy channel, heavily shaded on one side of the road, which we avoided. On the other side there was a shallower stream which was "solid" with macrophytes. The very low pollution rating given by Watanabe is misleading. The Japanese streams appear to be heavily polluted and his ratings are very heavily weighted that way. Other workers, although agreeing *Cocconeis* grows in clean water, they all agree it does not occur in the oligotrophic waters.

3.2.30 Site 30, TF724121 R. Nar

Site description

Stream width	6 m
Depth	0.2 m
Water velocity	medium
Water clarity	clear
Substratum	70% sand, 20% gravel, 10% silt (<5% *Callitriche, Rorippa, Ranunculus)*
Bank	50% canopy cover; bank, grass
Land use	north bank, arable fields; south bank arable land behind a line of poplars
Sample location	sample taken from near north bank

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	5.8
minutissima	16.5
Amphora pediculus	13.2
Cocconeis placentula var. *euglypta*	11.9
Gomphonema angustatum	15.2
Navicula veneta	13.2

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG3	→
5.	HMSO (1993)	3	→

Comment

There apppeared to be a thin brown floc on the stones and these were a thin covering of diatoms.

3.2.31 Site 31, TF722123 small side tributary

Site description

Stream width	2 m
Depth	0.25 m
Water velocity	medium
Water clarity	clear
Substratum	95% silt, chalk fragments at the margin
Bank	open canopy, grass
Land use	arable fields
Sample location	no stones available; sample of grass trailing at the margin taken

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes minutissima	46.4
Amphora pediculus	12.6
Cocconeis placentula var. *euglypta*	11.7
Navicula gracilis	5.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1/2 SG2	→
5.	HMSO (1993)	3	→

Comment

Only epiphytes could be samples at this site due to the very high level of silt

3.2.32 Site 32, TF735146 first main tributary source A1

Site description

Site indicated by the NRA was a small ditch 200 m from the confluence with the main channel. The ditch was full of leaves and overgrown with grass and impossible to sample. The main channel had slow flowing water and was largely soft sediments. However, at one small point some work had clearly been carried out on the bed of the channel, the base was slightly raised and in consequence the water was shallower and flowed more swiftly revealing a few stones. These were sampled!

Stream width	1.5 m
Depth	0.03 m
Water velocity	medium
Water clarity	clear
Substratum	a small area of gravel over clay and soft sediments
Bank	50% canopy cover; north bank, grass; south bank, willow scrub
Land use	grazed fields
Sample location	sample taken in small riffle; high trapezoidal banks 2 m high

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	48.3
Amphora pediculus	13.3
Navicula veneta	15.6

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1/2 SG2	→
5.	HMSO (1993)	2/3	→

Comment

There was a small amount of lime-encrusting population of Chlorophyceae and Cyanobacteria but generally the stones were covered with a thin layer of detritus containing a few diatoms

3.2.33 Site 33, TF734146 first main tributary A2

Site description

Stream width	1.5 m
Depth	0.14 m
Water velocity	medium
Water clarity	clear
Substratum	98% silt; very little gravel. Occasional plants of *Typha latifolia*, *Epilobium*, *Rorippa nasturtium-aquaticum* and *Callitriche*.
Bank	75% canopy cover; young alder, ash, bramble and willow herb
Land use	north bank, private garden; south bank, wood
Sample location	channel canalised and set in a gulley

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	11.2
minutissima	36.7
Amphora pediculus	30.2
construens	7.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comment

Very clean stones with only a few diatoms. Another apparently clean site.

3.2.34 Site 34, TF708137 first main tributary A3

Site description

Stream width	2 m
Depth	0.25 m
Water velocity	medium
Water clarity	clear
Substratum	30% gravel, 40% sand, 30% soft sediment (wood debris in the river)
Bank	closed canopy, wooded
Land use	woodland
Sample location	very clean stones

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	17.0
minutissima	29.5
Amphora pediculus	5.0
Cocconeis placentula var. *euglypta*	46.5

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Xen/Eur	
4.	Coste and Descy (1990)	G1/2 SG2	→
5.	HMSO (1993)	3	→

Comment

A very clean set of stones with no lime-encrusted algae.

3.2.35 Site 35, TF715155 second main tributary source B1

Site description

Stream width	2.5 m
Depth	0.3 m
Water velocity	fast
Water clarity	clear
Substratum	>90% silt/sand; occasional plants of *Epilobium, Callitriche, Rorippa*
Bank	open canopy; grass
Land use	grassed fields
Sample location	canalized, managed channel

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	20.2
minutissima	15.8
Amphora pediculus	12.3
Cocconeis placentula var. *euglypta*	29.4
Melosira varians	7.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Xen/Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comment

As for site 33, except there were even fewer diatoms, inspite of their being no canopy. What diatoms there were indicated a clean if eutrophic site.

3.2.36 Site 36, TF698121 R. Nar

Site description

Stream width	8 m
Depth	0.46 m; 1 m at maximum depth
Water velocity	fast
Water clarity	clear
Substratum	10% gravel, 20% sand/silt, 50% *Ranunculus*, 20% *Phragmites*
Bank	open canopy; grassed verge, highly managed.
Land use	arable fields (currently ploughed)
Sample location	uniform channel, sample taken close to west bank

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	8.0
minutissima	28.0
Amphora pediculus	7.6
Cocconeis placentula var. *euglypta*	13.8
Gomphonema angustatum	7.6
Rhoicosphenia curvata	18.2

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1 SG2	→
5.	HMSO (1993)	3	→

Comment

There appeared to be some very old encrusted lime on these stones. But the diatom population was healthy and representative of a clean but eutrophic stream.

3.2.37 Site 37, TF672135 R. Nar

Site description

The river was contained within an embankment higher than the surrounding land.

Stream width	10 m
Depth	>1 m
Water velocity	medium
Water clarity	cloudy
Substratum	soft sediments, possibly silt or sand (too deep to see); ***Phalaris arundinacea*** at the margins with occasional *Veronica* plants.
Bank	open, no canopy; grassed banks
Land use	north, rough grazing; south, arable
Sample location	river wide and turbid and too deep to collect stones; plants collected for epiphytes.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	5.3
minutissima	45.1
Navicula gregaria	13.7

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1 SG3	→
5.	HMSO (1993)	3	→

Comment

Only epiphytes sampled at this site

3.2.38 Site 38, TF699133 first main tributary A4

Site description

Stream runs out of a lake 20 m upstream. Banks lined with alder and birch creating a 20 m margin between the stream and the plantation. The channel emerges from a pipe under the road and then flows through a conifer plantation.

Stream width	3 m
Depth	0.15 m
Water velocity	medium
Water clarity	clear
Substratum	<5% gravel, the remainder was sand and debris
Bank	closed canopy; trees
Land use	woodland
Sample location	main body of the stream, just downstream of the road bridge

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	19.7
minutissima	19.2
Fragilaria construens	10.1
Navicula gracilis	7.6

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	2a/3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comment

Another set of clean stones.

3.2.39 Site 39, TF689133 first main tributary A5

Site description

Channel was highly managed, had been recently dredged and the banks cut.

Stream width	2 m
Depth	0.4 m
Water velocity	fast in the main flow, moderate at the margins
Water clarity	cloudy
Substratum	60% gravel, 20% sand, 10% soft sediments; isolated plants of *Glyceria* and *Apium*
Bank	open, no canopy; north bank, private garden; south bank, *Phalaris*
Land use	north, private garden; south, waste land
Sample location	centre of stream

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes minutissima 75.0

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G1 SG3	→
5.	HMSO (1993)	2/3	→

Comment

Relatively clean stones, but there must have been some silt contamination to account for the *Gyrosigma* present. Although few in numbers this species was particularly significant because of its large size.

3.2.40 Site 40, TF702149 second main tributary B2

Site description

Stream width	3 m
Depth	0.14 m at sample; 0.32 m maximum depth
Water velocity	medium
Water clarity	clear
Substratum	60% gravel, 30% sand, 10% soft sediment and debris
Bank	closed canopy; alder, sycamore, rhododendron, ferns and brambles
Land use	woodland
Sample location	channel showed little evidence of management

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lanceolata	20.4
minutissima	22.6
Cocconeis placentula var. *euglypta*	11.5
Fragilaria capucina	8.8
Melosira varians	17.7

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3/4	←
2.	Lange-Bertalot (1979)	2a/3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comment

Like the last site, there appears to be silt contaminating the epilithon. Both *Gyrosigma* and *Nitzschia sigmoidea* were seen in the live count, although the latter did not occur in the count.

3.2.41 Site 41, TF685145 second main tributary B3

Site description

Stream width	1.5 m
Depth	0.2 m
Water velocity	fast
Water clarity	clear
Substratum	90% gravel, 10% sand and soft sediment; individual plants of *Veronica*
Bank	open, no canopy; grass
Land use	arable
Sample location	Highly managed uniform channel; steep banks 3 m high

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes minutissima	12.1
Amphora pediculus	19.1
Fragilaria capucina	6.3
Navicula avenacea	5.1
gregaria	28.5
veneta	5.9

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	2a/2b	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2→4 SG3	→
5.	HMSO (1993)	3	→

Comment

The was a very visible covering of diatoms at this site. There is a considerable indication at this site (as well as the succeeding sites, 42, 43 and 44) that the water quality was degrading.

3.2.42 Site 42, TF679141 combined main tributaries AB6

Site description

Stream width	3 m
Depth	0.5 m at edge; >1 m in the middle
Water velocity	slow
Water clarity	turbid
Substratum	not visible; isolated *Veronica* plants
Bank	open, no canopy; grass
Land use	north, willow and alder scrub; south fields
Sample location	river canalised and managed; turbid water coming out of nearby drain; epiphytic algae sampled from submerged leaves.

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes minutissima	24.0
Cocconeis placentula var. *euglypta*	10.1
Melosira varians	26.0
Navicula gregaria	14.3

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G4 SG3	→
5.	HMSO (1993)	3	→

Comment

At this and sites 43 and 44 (which are next to each other along the tributary) only epiphytes could be samples. Like site 41 there was some indication of deterioration in quality.

3.2.43 Site 43, TF674141 combined main tributaries AB7

Site description

Stream width	3 m
Depth	0.4 m
Water velocity	slow
Water clarity	cloudy
Substratum	100% sand and soft sediment; isolated plants of *Apium* and *Veronica*
Bank	open, no canopy; grass
Land use	fields
Sample location	managed, uniform canalised system; plant material sampled for epiphytes

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes minutissima	11.4
Melosira varians	29.9
Navicula cryptocephala	9.0
Nitzschia dissipata	6.6

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G4 SG4	→
5.	HMSO (1993)	3	→

Comment

See sites 41 and 42 for comments.

3.2.44 Site 44, TF670137 combined main tributaries AB8

Site description

Stream width	4.5 m
Depth	0.5 m at the margins; > 1m at its maximum
Water velocity	slow
Water clarity	turbid
Substratum	bed not visible; *Phalaris* at the margins with isolated plants of *Epilobium* and *Iris pseudacorus*
Bank	open, no canopy; grass
Land use	fields
Sample location	channel is canalised, uniform and highly managed; sample of trailing plants taken for epiphytes

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes minutissima	7.1
Melosira varians	39.2
Navicula gregaria	12.5
minuscula	7.5
veneta	6.3

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	3	←
2.	Lange-Bertalot (1979)	2a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G4 SG2	→
5.	HMSO (1993)	3	→

Comment

See sites 41 and 42 for comment.

3.2.45 Site 45, TF636135 R Nar; well below confluence with the main tributaries

Site description

Stream width	11 m
Depth	0.23 cm; approximately 1 m deep at the maximum depth
Water velocity	slow
Water clarity	clear
Substratum	30% gravel, 70% sand, 20% *Ranunculus penicillatus* var. *calcareus* and isolated plants of *Carex*
Bank	open, no canopy; grass
Land use	north, grazed field; south, road
Sample location	banks, highly managed, canalised

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes lauenbergiana	5.7
minutissima	10.6
Amphora pediculus	47.1
Navicula minima	13.7

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	5	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG2	→
5.	HMSO (1993)	3	→

Comment

Although downstream of sites 41 - 44, this site appeared to be of better overall quality.

3.2.46 Site 46, TF621182 R. Nar near King's Lynn

Site description

The river was contained in concrete banks several metres high. The site is possibly tidal and the mud on the banks was wet.

Stream width	13 m
Depth	> 1 m
Water velocity	slow
Water clarity	cloudy
Substratum	bed not visible, no gravel visible; margins of *Glyceria* and *Phalaris*
Bank	open, no canopy; nettles and ivy; bare mud margin between the bank and the water, 1 m high
Land use	derelict land and buildings
Sample location	sample taken from a lump of concrete at the margin which had recently been submerged; sample taken just upstream of a sluice gate

Summary of the results. Percentage distribution of diatom taxa comprising more than 5% of the total.

Achnanthes minutissima	65.6
Amphora veneta	6.3
Navicula gregaria	6.9

Pollution / eutrophication status

		status	saprobic direction 1 - 5
1.	Descy (1979)	4	←
2.	Lange-Bertalot (1979)	3a	←
3.	Watanabe et al. (1986)	Eur	
4.	Coste and Descy (1990)	G2 SG3	→
5.	HMSO (1993)	3	→

Comment

Although tidal, this site was not marine, except for a few species which are tolerant of high conductivity waters. It was not a degraded site.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 The River was not surveyed at an ideal time. Between July and September would have been preferable since discharge would be at its lowest level, biological activity at its greater and the impact of degraded imputs would be at a maximum.

4.2 The sampling method (HMSO 1993) was not ideal at all sites, due to canopy, slow flow and excessive silt.

4.3 True epilithon was not always available and at six sites epiphyton had to be sampled.

4.4 Most of the sites fitted into pollution category 3. This is indicative of alkaline, enriched but not seriously polluted system. Since this method did not significantly separate the sites, several other methods were used. The method developed by Coste and Descy (1990) is useful because it separates the effects of pollution from increased alkalinity, an important difference in chalk streams. Interestingly most of them suggested that most of the upper catchment source waters were more stressed than the downstream sites, although nutrient concentrations did not decrease downstream; if anything phosphate levels were high. Downstream sites 40 - 44 showed some early signs of further degradation

4.5 The R. Nar is nutrient rich from the source (approximately 10 mg l^{-1} NO_3-N, about twice that of sources of chalk streams in Dorset) and this may reflect the dominance of *Achnanthes lanceolata* at these sources. At lower nitrogen levels *Meridion* would be more abundant. It is unfortunate that HMSO (1993) does not use *A. lanceolata* in any of the five pollution categories. But extrapolating from continental saprobic systems, it would appear that this diatom is more frequent in the nutrient rich or more degraded waters.

4.6 Further downstream classic chalk-stream diatoms were observed, including *Achnanthes minutissima, Amphora pediculus, Navicula avenacea* and *Navicula gracilis*, characteristic of clean, although eutrophic, chalk streams, inspite of increasing phosphate concentrations and high nitrate levels. At several sites very large coatings of diatoms were found covering the gravel (frequently dominated by *Navicula avenacea*) and this is also typical of the diatom populations which grow in profusion in the spring in chalk streams.

4.7 The presence of *Melosira varians* and *Fragilaria* spp. reflected the slow-flowing and canalised nature of many of the sites.

4.8 It is possible that parts of the River Nar could degrade either during the summer or in the future. The presence of small percentages of *Navicula veneta* and *Amphora veneta* is indicative; however both *Gomphonema parvulum* and *Nitzschia palea* were only present in small numbers. The presence of *Navicula muralis* is also indicative of a degraded input. Sites to watch in the future, particularly in summer, are those close to effluents of sewage works in small streams (sites 4-5 and 22-23) and sites near fish farms (sites 24, 25, 28, 43 and 44).

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6. APPENDIX

6.1 Diatom taxa referred to in this report

Achnanthes conspicua A. Mayer
delicatula Kütz.
lanceolata Bréb.
lauenbergiana Hustedt
minutissima Kütz.
Amphora ovalis Kütz.
pediculus (Kutz.) Grun. [also *A. ovalis* var. *pediculus*]
veneta Kütz.
Caloneis amphisbaena (Bory) Cleve
Cocconeis disculus Schum.
pediculus (Ehr.)
placentula (Ehr.)
var. *euglypta* (Ehr.) Cleve
var. *lineata* (Ehr.) Cleve
Cymbella minuta Hilse [*Cymbella ventricosa*]
Cyclotella spp.
Diatoma haemale (Lyngbye) Heiberg
vulgare Bory
Diploneis puella (Schumann) Cleve
Eunotia pectinalis var. *minor* (Kutz.) Rabh.
Fragilaria brevistriata Grun.
capucina Desmazieres
construens (Ehr.) Grun.
intermedia Grun.
laponica Grun.
pinnata Ehr.
virescens Ralfs
Gomphonema acuminatum var. *Brebissonii* (Kütz.)
angustatum (Kutz.) Rabh.
augur Ehr.
olivaceum (Lyngbye) Kütz.
var. *calcare* Cleve
parvulum Kütz.
truncatum Ehr.
Gyrosigma acuminatum (Kütz.) Rabh.
Hantzschia amphioxus (Ehr.) Grun.
Melosira granulata (Ehr.) Ralfs
varians C.A. Ag.
Meridion circulare Agardh

Navicula avenacea (Bréb.) [*N. viridula* var. *avenacea* (Breb.) Grun.]
[*N. lanceolata* W. Smith]
cryptocephala Kütz.
gracilis Ehr.
gregaria Donkin
menisculus Schumann
minima Grun.
minuscula Grun.
muralis Grun.
pupula var. *nyassensis* (O. Muller) Lange-Bertalot
salinarum Grun.
slesvicensis Grun. [*N. viridula* var. *slesvicensis* (Grun.) Van Hewick]
veneta Kütz.
Nitzschia acicularis W. Smith
acula Hantzsch.
amphibia Grun.
dissipata (Kütz.) Grun.
capetellata Hust.
frustulum Kütz.
holastica Hust.
Kützingiana Hilse
linearis W. Smith
palea (Kütz.) W. Smith
paleacea Grun.
recta Hantzsch.
Reimeria sinuata Greg. [*Cymbella sinuata*]
Rhoicosphenia curvata (Kütz.) Grun.
Surirella linearis var. *constricta* (Grun.) Hust.
ovata Kütz.
Synedra affinis Kütz.
pulchella Kütz.
ulna Ehr.

6.2 Percentage distribution of diatoms

Table 1 --- sites 1 - 7
Table 2 --- sites 8 - 14
Table 3 --- sites 15 - 21
Table 4 --- sites 22 - 28
Table 5 --- sites 29 - 33
Table 6 --- sites 34 - 40
Table 7 --- sites 41 - 46

Table 1 Percentage abundance of diatoms; sites 1 - 7.

SITE	1	2	3	4	5	6	7
Achnanthes conspicua	0.0	0.0	0.0	0.0	0.0	0.0	0.4
delicatula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lanceolata	63.4	84.7	63.2	27.7	37.9	8.0	10.7
lauenbergiana	3.4	0.0	0.3	10.3	10.6	10.2	1.8
minutissima	7.0	0.0	3.1	7.9	2.7	2.2	3.1
Amphora ovalis	0.0	0.0	0.0	0.8	0.0	0.0	0.0
pediculus	0.0	0.0	0.6	28.5	4.5	6.2	5.3
veneta	0.0	0.0	0.0	0.0	0.4	0.0	0.4
Caloneis amphisbaena	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cocconeis disculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pediculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
placentula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
var. eug	0.0	0.0	0.3	0.0	0.0	0.0	4.0
var. lineata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cymbella minuta	0.0	0.0	0.0	0.8	0.0	0.0	0.0
Cyclotella spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diatoma haemale	0.0	0.0	0.0	0.0	0.0	0.0	0.0
vulgare	0.0	0.4	0.0	1.2	0.0	0.0	0.0
Diploneis puella	0.0	0.0	0.0	0.0	0.4	0.0	0.0
Eunotia pect var.minor	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1. (continued, sites 1 - 7)

Fragilaria brevistriata	0.0	0.0	0.0	1.2	0.0	0.0	0.0
capucina	1.2	0.0	0.6	0.0	0.0	0.0	0.0
construens	0.9	0.0	0.0	1.6	1.9	0.0	0.0
intermedia	2.1	0.0	0.0	0.0	0.0	0.0	0.0
laponica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pinnata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
virescens	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Gomphonema acum var.Breb	0.0	0.0	0.0	0.0	0.0	0.0	0.0
angustatum.	0.3	6.9	16.5	0.8	11.0	7.1	13.3
augur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
olivaceum.	0.0	0.0	2.5	0.0	0.0	3.1	3.1
var.calcare	0.0	0.0	0.0	0.0	0.0	0.0	1.8
parvulum	0.0	0.0	0.3	0.0	0.0	0.0	1.8
truncatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.0	0.6	0.4	0.0	0.0	0.0
Gyrosigma acuminatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hantzschia amphioxus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Melosira granulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
varians	4.6	0.0	0.0	0.0	0.0	0.0	2.7
Meridion circulare	9.8	7.3	7.8	2.0	3.8	2.2	3.1
Navicula avenacea	0.0	0.0	0.0	1.6	1.5	5.8	17.3
cryptocephala	0.0	0.0	0.0	0.0	0.0	0.0	0.0
gracilis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
gregaria	0.3	0.0	1.9	5.9	7.6	24.3	12.4

Table 1. (continued, sites 1 - 7)

Navicula hungarica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
menisculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
minima	2.1	0.0	0.3	1.2	3.0	8.0	6.2
minuscula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
muralis	0.0	0.0	0.0	0.0	3.8	0.0	0.0
pupula var.nyass	0.0	0.0	0.0	0.0	0.0	0.0	0.0
radiosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0
salinarum	0.0	0.0	0.3	0.0	0.0	0.0	0.0
slesvicensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
veneta	2.7	0.0	0.0	4.0	1.9	3.1	1.8
spp	0.0	0.0	0.0	0.0	0.0	1.8	0.0
Nitzschia acicularis	0.0	0.0	0.0	0.0	0.4	0.0	0.0
acula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
amphibia	0.0	0.0	0.0	0.0	0.0	0.4	0.0
dissipata	0.0	0.0	0.0	0.0	0.0	0.0	1.3
capetellata	0.0	0.0	0.0	0.0	0.0	0.0	0.9
frustulum	0.0	0.0	0.0	0.0	1.1	0.9	0.9
holastica	0.0	0.0	0.0	0.0	3.8	0.0	0.0
Kutzingiana	0.0	0.0	0.0	0.0	0.0	0.0	0.0
linearis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
palea	0.0	0.0	0.0	0.0	0.0	0.0	0.0
paleacea	0.0	0.0	0.0	0.0	0.0	0.0	0.0
recta	0.0	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.3	0.4	0.9	0.0	0.0	0.0	0.0

Table 1. (continued, sites 1 - 7)

Reimeria sinuata	0.0	0.0	0.0	0.0	0.0	2.7	0.0
Rhoicosphenia curvata	0.0	0.0	0.0	0.0	0.0	5.8	1.8
Surirella linearis var.const	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ovata	0.0	0.0	0.6	2.8	1.1	3.5	4.9
Synedra affinis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pulchella	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ulna	1.8	0.4	0.0	1.6	2.7	4.9	0.4
Miscellaneous diatoms	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2. Percentage adundance of diatoms; sites 8 - 14.

SITE	8	9	10	11	12	13	14
Achnanthes conspicua	0.3	0.0	0.0	0.0	0.0	0.0	0.0
delicatula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lanceolata	10.1	19.2	6.1	32.3	6.2	7.9	78.7
lauenbergiana	14.5	0.0	5.3	0.0	0.0	2.8	0.0
minutissima	0.0	5.1	3.4	8.2	2.9	46.6	3.7
Amphora ovalis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pediculus	25.6	1.7	11.8	0.0	1.9	22.4	0.0
veneta	2.4	0.0	0.0	0.0	0.0	0.7	0.0
Caloneis amphisbaena	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cocconeis disculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pediculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
placentula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
var. eug	0.7	0.0	0.8	0.0	0.0	2.1	0.0
var. lineata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cymbella minuta	0.0	1.1	0.8	0.4	1.0	0.0	0.8
Cyclotella spp.	0.0	0.0	0.0	0.0	1.4	0.0	0.0
Diatoma haemale	0.3	0.0	0.0	0.0	0.0	0.0	0.0
vulgare	0.0	0.0	0.0	0.0	1.0	0.3	0.0
Diploneis puella	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eunotia pect var.minor	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2. (continued, sites 8 - 14)

Fragilaria brevistriata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
capucina	0.0	1.7	0.0	2.9	10.0	2.8	1.6
construens	31.3	20.9	17.9	0.0	0.0	0.0	0.0
intermedia	0.0	2.3	0.0	0.0	0.0	0.0	0.0
laponica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pinnata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
virescens	0.0	4.5	0.0	1.8	0.0	0.7	0.0
Gomphonema acum var.Breb	0.0	0.0	0.0	0.0	0.0	0.0	0.0
angustatum.	0.0	7.9	0.0	16.8	5.7	0.0	4.5
augur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
olivaceum.	0.7	1.7	0.0	0.7	5.3	5.2	0.0
var.calcare	0.0	0.0	0.0	0.0	0.0	0.0	0.0
parvulum	0.3	0.0	0.0	1.4	0.5	0.0	0.0
truncatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gyrosigma acuminatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hantzschia amphioxus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Melosira granulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
varians	0.0	11.3	0.0	0.0	1.0	0.3	0.4
Meridion circulare	0.0	0.0	0.8	11.1	4.3	0.3	0.0
Navicula avenacea	3.4	0.6	30.0	0.0	44.0	0.7	0.0
cryptocephala	0.0	0.6	0.0	0.0	0.0	0.0	0.0
gracilis	0.0	0.0	3.0	0.0	0.0	0.0	0.0
gregaria	0.7	4.0	6.1	2.2	3.8	1.4	0.0

Table 2 (continued, sites 8 - 14)

Navicula hungarica	0.0	0.6	0.0	0.0	0.0	0.7	0.0
menisculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
minima	4.0	2.3	1.5	6.1	0.5	0.0	0.4
minuscula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
muralis	0.0	1.1	0.8	0.7	0.0	0.7	0.0
pupula var.nyass	0.0	0.0	0.0	0.0	0.0	0.0	0.0
radiosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0
salinarum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
slesvicensis	0.0	0.6	0.0	0.0	0.0	0.0	0.0
veneta	1.0	1.1	0.8	9.3	1.9	0.3	0.0
spp	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitzschia acicularis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
acula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
amphibia	0.0	1.1	0.0	0.0	0.0	0.0	0.0
dissipata	0.0	0.0	0.0	0.0	1.0	0.7	0.0
capetellata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
frustulum	2.7	1.1	1.5	0.0	0.0	2.4	0.8
holastica	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Kutzingiana	0.0	4.5	0.0	0.0	0.0	0.0	0.0
linearis	0.0	1.1	0.0	0.0	0.0	0.0	1.2
palea	0.3	0.0	0.0	0.0	0.0	0.0	0.0
paleacea	0.0	0.0	0.0	0.7	0.0	0.0	0.4
recta	0.0	0.0	0.0	2.2	0.0	0.0	0.0
spp	0.0	0.0	0.0	0.0	4.3	0.0	0.0

Table 2 (continued, sites 8 - 14)

Reimeria sinuata	0.3	0.0	0.0	0.0	0.0	0.7	0.8
Rhoicosphenia curvata	0.0	0.0	1.9	0.0	0.0	0.0	0.0
Surirella linearis var.const	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ovata	0.0	0.0	1.5	0.4	1.0	0.0	0.8
Synedra affinis	0.7	0.0	0.0	0.0	0.0	0.0	0.4
pulchella	0.0	0.6	0.0	0.0	0.0	0.0	0.0
ulna	0.0	2.3	6.1	2.9	2.4	0.3	4.1
Miscellaneous diatoms	0.0	1.1	0.0	0.0	0.0	0.0	1.2

Table 3. Percentage abundance of diatoms; sites 15 - 21

SITE	15	16	17	18	19	20	21
Achnanthes conspicua	0.0	0.0	0.0	0.5	0.0	0.0	3.9
delicatula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lanceolata	8.6	8.8	2.5	7.5	11.9	6.5	9.3
lauenbergiana	0.0	0.0	0.8	1.0	0.9	0.0	12.1
minutissima	10.1	17.6	43.5	19.5	46.3	14.6	23.7
Amphora ovalis	0.7	0.0	0.0	0.0	0.0	0.0	0.0
pediculus	19.8	14.6	23.2	13.0	14.7	2.4	24.5
veneta	0.4	2.5	1.7	4.0	3.7	0.8	3.9
Caloneis amphisbaena	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cocconeis disculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pediculus	0.0	0.0	0.0	0.0	0.0	1.6	0.0
placentula	0.0	0.8	0.0	0.0	0.0	0.0	0.0
var. eug	3.6	12.1	3.4	1.0	1.8	62.8	2.7
var. lineata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cymbella minuta	0.0	1.7	0.4	0.0	0.0	0.0	0.4
Cyclotella spp.	1.1	0.0	0.0	0.0	0.0	0.0	0.0
Diatoma haemale	0.0	0.0	0.0	0.0	0.0	0.0	0.0
vulgare	0.0	0.0	0.0	1.0	0.0	0.0	0.0
Diploneis puella	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Eunotia pect var.minor	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3 (continued, sites 15 - 21)

Fragilaria brevistriata	1.4	0.0	0.0	0.0	0.0	0.0	0.0
capucina	18.3	1.7	1.7	8.5	0.0	0.0	0.0
construens	0.0	0.0	0.4	6.0	8.7	0.0	0.8
intermedia	0.0	0.0	0.0	0.0	0.0	0.0	0.0
laponica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pinnata	0.0	0.0	0.0	26.5	2.3	0.0	0.8
virescens	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gomphonema acum var.Breb	0.0	0.0	0.0	0.0	0.0	0.0	0.0
angustatum.	2.5	13.0	5.1	2.0	0.0	0.0	0.0
augur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
olivaceum.	0.0	1.7	0.0	0.0	0.9	0.8	0.0
var.calcare	0.0	0.0	0.0	0.0	0.0	0.0	0.0
parvulum	0.0	0.0	0.0	0.0	0.0	0.0	0.8
truncatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gyrosigma acuminatum	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Hantzschia amphioxus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Melosira granulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
varians	2.9	3.3	0.4	0.0	0.5	0.4	1.6
Meridion circulare	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Navicula avenacea	0.7	0.0	0.8	0.0	0.0	0.4	0.0
cryptocephala	0.0	0.0	0.0	0.0	0.0	0.0	0.0
gracilis	1.1	0.0	0.4	1.0	0.0	2.4	0.8
gregaria	11.2	3.3	9.7	3.5	1.8	2.0	1.9

Table 3 (continued, sites 15 - 21)

Navicula hungarica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
menisculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
minima	0.7	1.7	1.7	1.0	0.0	0.0	6.2
minuscula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
muralis	0.7	0.0	0.0	0.0	0.0	0.0	0.0
pupula var.nyass	0.0	0.0	0.0	0.0	0.0	0.0	0.0
radiosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0
salinarum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
slesvicensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
veneta	9.0	7.9	2.5	1.0	2.8	3.2	1.6
spp	0.0	0.0	0.0	0.0	0.0	0.0	2.3
Nitzschia acicularis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
acula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
amphibia	0.0	0.0	0.0	0.0	0.9	0.8	0.0
dissipata	1.4	0.0	0.4	0.0	0.5	0.0	0.4
capetellata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
frustulum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
holastica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kutzingiana	0.0	0.0	0.0	0.0	0.0	0.0	0.0
linearis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
palea	0.0	1.3	0.8	0.0	0.5	0.0	0.0
paleacea	2.9	0.0	0.0	0.0	0.0	0.0	0.4
recta	0.7	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3 (continued, sites 15 - 21)

Reimeria sinuata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rhoicosphenia curvata	0.0	0.8	0.0	1.0	0.0	0.0	0.8
Surirella linearis var.const	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ovata	1.4	0.0	0.0	0.0	0.0	0.0	0.0
Synedra affinis	0.0	0.0	0.0	0.0	0.9	0.0	0.0
pulchella	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ulna	0.0	4.6	0.4	2.0	0.9	1.2	1.2
Miscellaneous diatoms	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4. Percentage abundance of diatoms; sites 22 - 28

SITE	22	23	24	25	26	27	28
Achnanthes conspicua	1.8	0.0	1.0	0.9	0.0	0.0	0.3
delicatula	0.0	0.4	0.0	0.0	0.0	0.0	2.0
lanceolata	10.1	8.0	4.0	11.3	6.8	6.3	5.3
lauenbergiana	3.2	3.8	1.5	2.8	0.0	3.0	1.8
minutissima	4.1	46.0	4.5	6.6	4.3	14.3	10.8
Amphora ovalis	0.0	0.0	0.0	0.0	0.0	0.0	0.3
pediculus	45.6	7.6	10.4	46.5	7.4	35.4	22.6
veneta	2.3	0.8	1.0	0.0	2.5	2.5	2.0
Caloneis amphisbaena	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Cocconeis disculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pediculus	0.0	0.0	0.0	0.0	0.0	0.0	0.5
placentula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
var. eug	3.7	2.3	6.0	4.2	13.0	4.2	5.0
var. lineata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cymbella minuta	0.0	0.8	0.0	2.8	1.2	0.0	1.0
Cyclotella spp.	0.0	0.8	1.0	0.0	0.6	1.3	1.5
Diatoma haemale	0.0	0.0	0.0	0.0	0.0	0.0	0.0
vulgare	0.0	0.0	2.5	0.0	1.2	0.8	1.0
Diploneis puella	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Eunotia pect var.minor	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4. (continued, sites 22 - 28)

Fragilaria brevistriata	0.0	0.0	0.0	0.0	0.6	0.0	0.0
capucina	0.0	0.0	0.0	0.0	9.3	0.0	2.0
construens	2.8	6.5	34.8	12.2	17.9	1.7	14.8
intermedia	0.0	0.0	0.0	0.0	0.0	0.0	1.3
laponica	0.0	0.0	0.0	0.0	0.6	0.0	0.0
pinnata	8.8	3.0	0.0	0.5	12.3	3.4	3.5
virescens	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gomphonema acum var.Breb	0.0	0.0	0.0	0.0	0.0	0.0	0.0
angustatum.	0.0	0.0	0.0	0.0	0.0	1.7	1.5
augur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
olivaceum.	0.0	0.0	0.0	0.9	0.0	0.0	1.3
var.calcare	0.0	0.8	0.0	0.0	0.0	0.0	0.0
parvulum	0.0	0.0	0.0	0.0	0.0	1.7	0.3
truncatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.8	0.0	0.0	0.0	0.0	0.0
Gyrosigma acuminatum	0.0	0.0	6.0	0.9	0.0	0.0	0.0
Hantzschia amphioxus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Melosira granulata	0.0	0.0	2.5	0.0	0.0	0.0	0.0
varians	0.0	1.5	0.0	0.0	4.9	0.0	1.5
Meridion circulare	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Navicula avenacea	0.0	0.0	2.0	0.0	0.0	0.0	1.5
cryptocephala	0.0	0.0	0.0	0.0	0.0	0.0	0.5
gracilis	5.1	4.9	7.5	3.3	2.5	3.4	4.3
gregaria	3.7	2.7	1.0	0.9	1.2	0.8	1.8

Table 4. (continued, sites 22 - 28)

Navicula hungarica	0.0	0.0	0.5	0.0	0.0	0.0	0.0
menisculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
minima	1.8	0.0	3.0	0.0	4.9	10.1	1.0
minuscula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
muralis	0.0	0.0	0.0	0.0	0.0	0.4	0.0
pupula var.nyass	0.0	0.0	0.0	0.0	0.0	0.0	0.0
radiosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0
salinarum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
slesvicensis	0.0	0.0	0.5	0.0	0.0	0.0	0.0
veneta	3.7	3.4	4.0	0.0	1.2	4.2	4.8
spp	0.0	0.0	0.5	1.9	0.0	0.0	0.0
Nitzschia acicularis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
acula	0.0	0.0	0.0	0.0	0.0	0.4	0.0
amphibia	0.0	1.5	0.0	0.0	0.0	0.0	0.5
dissipata	0.0	1.1	1.0	1.9	0.0	0.8	0.0
capetellata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
frustulum	0.0	1.9	0.0	0.0	0.0	0.0	3.0
holastica	0.0	0.0	0.0	2.3	0.0	0.4	0.0
Kutzingiana	0.0	0.4	0.0	0.0	0.6	0.0	0.5
linearis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
palea	0.0	0.0	0.0	0.0	0.0	0.0	0.0
paleacea	0.0	1.1	3.0	0.0	0.0	0.0	0.0
recta	0.0	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.0	1.5	0.0	0.0	1.7	0.0
Reimeria sinuata	0.0	0.0	0.0	0.0	0.0	1.3	0.0

Table 4. (continued, sites 22 - 28)

Rhoicosphenia curvata	0.0	0.0	0.0	0.0	0.0	0.0	1.5
Surirella linearis var.const	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ovata	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Synedra affinis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pulchella	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ulna	0.0	0.0	0.0	0.0	3.7	0.0	0.0
Miscellaneous diatoms	3.2	0.0	0.0	0.0	3.1	0.0	0.0

Table 5. Percentage abundance of diatoms; sites 29 - 33

SITE	29a	29b	29c	30	31	32	33
Achnanthes conspicua	0.0	0.0	0.0	0.0	0.5	0.0	0.0
delicatula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lanceolata	3.4	10.1	6.6	5.8	2.7	2.8	11.2
lauenbergiana	0.0	0.0	0.0	0.0	4.1	0.0	0.0
minutissima	31.2	9.0	9.2	16.5	46.4	48.3	36.7
Amphora ovalis	3.4	0.0	0.9	0.0	0.0	0.0	0.0
pediculus	4.6	0.4	0.0	13.2	12.6	13.3	30.2
veneta	0.0	0.0	0.0	0.0	0.0	0.9	0.0
Caloneis amphisbaena	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cocconeis disculus	0.0	0.0	0.0	0.4	0.0	0.5	0.9
pediculus	0.0	6.5	4.4	0.0	0.0	0.0	0.0
placentula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
var. eug	8.0	69.8	53.9	11.9	11.7	4.3	3.3
var. lineata	0.0	3.2	0.0	0.0	0.0	0.0	0.0
Cymbella minuta	0.0	0.0	0.0	0.0	0.9	0.0	0.0
Cyclotella spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diatoma haemale	0.8	0.0	0.0	0.0	0.0	0.0	0.5
vulgare	1.7	0.0	0.9	4.1	0.0	4.7	0.0
Diploneis puella	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eunotia pect var.minor	0.0	0.0	1.3	0.0	0.0	0.0	0.0

Table 5. (continued, sites 29 - 33)

Fragilaria brevistriata	0.0	0.0	0.4	0.0	0.0	0.0	0.5
capucina	3.4	0.0	0.4	0.0	0.0	0.0	0.0
construens	0.0	0.0	0.0	0.0	0.0	0.0	7.0
intermedia	0.0	0.0	0.0	0.0	0.0	0.0	0.0
laponica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pinnata	1.3	0.0	1.8	2.5	0.0	0.0	0.0
virescens	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gomphonema acum var.Breb	0.0	0.0	0.0	0.0	0.0	0.0	0.0
angustatum.	0.0	0.0	0.4	15.2	0.0	0.0	0.0
augur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
olivaceum.	0.0	0.0	0.0	2.1	0.9	0.0	0.0
var.calcare	0.0	0.0	0.0	0.0	0.0	0.0	0.0
parvulum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
truncatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.0	0.0	1.2	0.0	0.0	0.0
Gyrosigma acuminatum	4.6	0.0	0.0	0.0	0.0	0.0	0.0
Hantzschia amphioxus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Melosira granulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
varians	3.0	0.0	2.2	0.0	4.5	0.0	0.0
Meridion circulare	0.0	0.0	3.1	0.0	0.0	0.0	0.0
Navicula avenacea	0.0	0.4	0.9	0.0	0.9	1.9	0.0
cryptocephala	0.0	0.0	0.0	0.8	0.5	0.9	0.0
gracilis	6.8	0.0	4.4	0.0	5.0	0.0	0.9
gregaria	3.4	0.0	1.8	2.9	4.1	3.8	0.9

Table 5. (continued, sites 29 - 33)

Navicula hungarica	0.0	0.0	0.4	0.0	0.0	0.0	0.0
menisculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
minima	0.0	0.0	0.0	0.8	2.3	1.4	1.4
minuscula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
muralis	0.0	0.0	0.0	0.0	0.5	0.0	0.0
pupula var.nyass	0.0	0.0	0.0	0.4	0.0	0.5	0.0
radiosa	0.0	0.0	0.4	0.0	0.0	0.0	0.0
salinarum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
slesvicensis	0.0	0.0	0.9	0.0	0.5	0.0	0.0
veneta	3.8	0.4	3.1	13.2	1.8	15.6	2.8
spp	0.0	0.4	0.9	4.1	0.0	0.0	0.0
Nitzschia acicularis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
acula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
amphibia	0.0	0.0	0.0	0.0	0.0	0.0	0.0
dissipata	10.1	0.0	0.0	0.8	0.0	0.9	2.3
capetellata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
frustulum	1.7	0.0	0.9	0.0	0.0	0.0	0.0
holastica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kutzingiana	0.0	0.0	0.0	0.0	0.0	0.0	0.0
linearis	1.3	0.0	0.0	0.0	0.0	0.0	0.0
palea	1.3	0.0	0.0	0.0	0.0	0.0	0.5
paleacea	0.8	0.0	0.9	0.0	0.0	0.0	0.0
recta	0.0	0.0	0.0	0.0	0.0	0.0	0.9
spp	0.0	0.0	0.0	0.8	0.0	0.0	0.0

Table 6. (continued, sites 29 - 33)

Reimeria sinuata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rhoicosphenia curvata	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Surirella linearis var.const	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ovata	0.8	0.0	0.0	0.0	0.0	0.0	0.0
Synedra affinis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pulchella	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ulna	4.6	0.0	0.0	0.0	0.5	0.0	0.0
Miscellaneous diatoms	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6. Percentage abundance of diatoms; sites 34 - 40

SITE	34	35	36	37	38	39	40
Achnanthes conspicua	0.0	0.0	0.0	0.0	0.0	0.0	0.0
delicatula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lanceolata	17.0	20.2	8.0	5.3	19.7	2.0	20.4
lauenbergiana	0.0	0.0	1.8	0.0	3.5	0.0	0.0
minutissima	29.5	15.8	28.0	45.1	19.2	75.0	22.6
Amphora ovalis	0.0	0.0	0.0	0.0	1.0	0.0	0.0
pediculus	5.0	12.3	7.6	3.5	0.0	2.0	4.4
veneta	0.0	0.9	0.0	0.9	0.0	0.0	0.9
Caloneis amphisbaena	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cocconeis disculus	1.0	0.0	0.0	0.0	0.0	0.0	0.0
pediculus	0.0	2.2	0.0	0.0	0.0	1.0	0.0
placentula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
var. eug	46.5	29.4	13.8	4.4	4.0	0.0	11.5
var. lineata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cymbella minuta	0.0	0.0	0.0	0.0	1.0	1.0	0.0
Cyclotella spp.	0.0	0.0	0.4	0.0	0.0	0.0	0.0
Diatoma haemale	0.0	0.0	0.4	0.0	0.0	0.0	0.0
vulgare	0.0	0.4	0.4	0.0	1.0	0.0	0.0
Diploneis puella	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eunotia pect var.minor	0.0	0.0	0.0	0.4	0.0	0.0	0.0

Table 6. (continued, sites 34 - 40)

Fragilaria brevistriata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
capucina	0.0	0.0	0.0	0.0	0.0	2.5	8.8
construens	0.0	0.0	0.0	1.3	10.1	0.0	0.0
intermedia	0.0	0.0	0.0	3.1	0.0	2.5	0.0
laponica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pinnata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
virescens	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gomphonema acum var.Breb	0.0	0.0	0.0	0.4	0.0	0.0	0.0
angustatum.	0.0	0.9	7.6	0.4	0.0	0.0	0.0
augur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
olivaceum.	0.0	2.2	1.8	1.8	1.0	0.0	0.0
var.calcare	0.0	0.0	2.2	2.2	0.0	0.0	0.0
parvulum	0.0	0.0	1.3	1.3	0.0	0.5	0.0
truncatum	0.0	0.0	0.0	0.4	0.0	0.0	0.0
spp	0.0	0.0	0.0	0.0	1.5	0.0	0.0
Gyrosigma acuminatum	0.0	0.4	0.0	0.0	0.0	0.0	0.9
Hantzschia amphioxus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Melosira granulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0
varians	0.0	7.0	0.0	0.0	0.0	0.0	17.7
Meridion circulare	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Navicula avenacea	1.0	0.4	0.0	0.0	2.5	0.0	0.9
cryptocephala	0.0	0.0	0.0	0.9	1.0	0.0	0.0
gracilis	0.0	0.4	1.8	0.9	7.6	1.0	0.9
gregaria	0.0	0.0	0.9	13.7	0.0	2.0	1.3

Table 6. (continued, sites 34 - 40)

Navicula hungarica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
menisculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0
minima	0.0	0.0	0.9	0.0	0.0	3.5	0.0
minuscula	0.0	0.0	0.0	0.0	0.0	0.0	0.0
muralis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pupula var.nyass	0.0	0.0	0.0	0.0	0.0	0.0	0.0
radiosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0
salinarum	0.0	0.0	0.0	0.0	0.0	0.0	0.0
slesvicensis	0.0	0.0	0.4	0.9	0.0	0.0	0.0
veneta	0.0	1.3	1.8	1.8	2.0	0.0	3.1
spp	0.0	0.0	0.0	0.0	1.5	1.5	0.9
Nitzschia acicularis	0.0	0.0	0.0	0.0	0.0	0.0	0.0
acula	0.0	0.0	0.0	0.0	2.0	0.0	0.0
amphibia	0.0	0.0	0.0	1.8	0.0	0.0	0.0
dissipata	0.0	0.0	0.0	2.2	1.0	0.0	0.0
capetellata	0.0	0.4	0.0	0.0	4.5	0.0	0.0
frustulum	0.0	0.0	2.2	4.0	0.0	0.0	0.0
holastica	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kutzingiana	0.0	0.0	0.0	0.0	0.0	0.0	0.0
linearis	0.0	0.4	0.4	0.0	3.0	0.0	0.0
palea	0.0	0.0	0.0	0.0	1.0	0.0	0.0
paleacea	0.0	0.0	0.0	0.0	2.0	0.0	0.0
recta	0.0	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6. (continued, sites 34 - 40)

Reimeria sinuata	0.0	1.8	0.0	0.9	0.0	2.0	0.0
Rhoicosphenia curvata	0.0	1.8	18.2	0.0	3.0	0.0	0.0
Surirella linearis var.const	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ovata	0.0	1.3	0.0	0.0	0.0	0.0	0.9
Synedra affinis	0.0	0.0	0.0	0.0	2.0	0.0	2.7
pulchella	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ulna	0.0	0.4	0.0	2.2	4.0	3.5	2.2
Miscellaneous diatoms	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					0.5		

Table 7. Percentage abundance of diatoms; sites 41 - 46

SITE	41.0	42.0	43.0	44.0	45.0	46.0
Achnanthes conspicua	0.0	0.0	0.0	0.0	0.0	0.0
delicatula	0.0	0.0	0.0	0.0	0.0	0.0
lanceolata	1.6	3.9	3.8	0.8	4.0	4.4
lauenbergiana	0.0	0.0	0.0	0.0	5.7	0.0
minutissima	12.1	24.0	11.4	7.1	10.6	65.6
Amphora ovalis	0.0	0.0	0.0	0.0	0.0	0.0
pediculus	19.1	0.0	0.9	0.0	47.1	1.3
veneta	3.1	0.0	0.5	0.4	2.6	6.3
Caloneis amphisbaena	0.0	0.0	0.0	0.0	0.0	0.0
Cocconeis disculus	0.0	0.0	0.0	0.0	0.0	0.0
pediculus	0.0	0.0	0.0	0.0	0.9	0.0
placentula	0.0	0.0	2.4	1.2	1.8	0.0
var. eug	2.0	10.1	0.0	0.0	2.2	0.0
var. lineata	0.0	0.0	0.0	0.0	0.0	0.0
Cymbella minuta	0.8	1.2	0.9	0.8	2.2	0.0
Cyclotella spp.	0.0	0.0	0.0	0.0	0.0	0.0
Diatoma haemale	0.0	0.0	0.0	0.0	0.0	0.0
vulgare	0.0	0.0	0.9	0.0	0.0	0.0
Diploneis puella	0.0	0.0	0.0	0.0	0.0	0.0
Eunotia pect var.minor	0.0	0.4	0.5	0.0	0.0	0.0

Table 7. (continued, sites 41 - 46)

Fragilaria brevistriata	0.0	0.0	0.0	0.0	0.0	0.0
capucina	6.3	1.6	0.9	6.3	0.0	0.0
construens	0.0	0.0	0.0	0.8	3.5	0.0
intermedia	0.0	0.0	0.0	0.0	0.0	0.0
laponica	0.0	0.0	0.0	0.0	0.0	0.0
pinnata	0.0	0.0	0.0	0.0	0.0	0.0
virescens	0.0	0.0	0.0	0.0	0.0	0.0
Gomphonema acum var.Breb	0.0	0.0	0.0	0.0	0.0	0.0
angustatum.	0.0	0.0	0.0	0.0	0.0	0.0
augur	0.0	0.8	0.0	0.0	0.0	0.0
olivaceum.	0.8	0.0	0.9	0.0	0.9	0.0
var.calcare	0.0	0.0	0.0	0.0	0.0	0.0
parvulum	2.3	0.0	0.0	0.0	0.4	0.0
truncatum	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.0	0.0	0.0	0.0	1.3
Gyrosigma acuminatum	0.0	0.0	1.9	0.8	0.0	0.0
Hantzschia amphioxus	0.0	0.0	0.0	0.4	0.0	0.0
Melosira granulata	0.0	0.0	0.0	0.0	0.0	0.0
varians	0.8	26.0	29.9	39.2	0.0	0.0
Meridion circulare	0.0	0.0	0.0	0.0	0.0	0.0
Navicula avenacea	5.1	0.8	1.9	0.8	0.0	0.0
cryptocephala	0.0	0.0	9.0	0.0	0.0	0.0
gracilis	0.8	0.0	2.4	2.0	0.9	0.0
gregaria	28.5	14.3	0.0	12.5	0.0	6.9

Table 7. (continued, sites 41 - 46)

Navicula hungarica	0.0	0.0	0.0	0.0	0.0	0.0
menisculus	0.0	0.0	0.0	0.0	0.4	0.0
minima	2.0	0.0	2.8	1.2	13.7	0.0
minuscula	0.0	0.0	0.0	7.5	0.0	0.0
muralis	0.0	0.0	0.0	1.2	0.0	1.3
pupula var.nyass	0.0	2.3	0.0	0.0	0.0	0.0
radiosa	0.0	0.0	0.0	0.0	0.0	0.0
salinarum	0.0	0.0	0.0	0.0	0.0	0.0
slesvicensis	0.0	3.1	2.8	0.4	0.0	0.0
veneta	5.9	0.8	1.9	6.3	0.0	4.4
spp	0.0	1.6	2.4	0.0	1.8	0.0
Nitzschia acicularis	0.0	0.0	0.0	0.0	0.0	0.0
acula	0.0	0.0	0.0	0.0	0.0	0.0
amphibia	0.0	0.8	3.8	2.0	0.9	3.8
dissipata	4.7	3.5	6.6	3.9	0.0	1.9
capetellata	0.8	0.0	0.0	0.0	0.0	0.6
frustulum	0.0	0.8	0.0	0.0	0.0	1.3
holastica	0.0	0.0	0.0	0.8	0.0	0.0
Kutzingiana	0.0	0.0	0.0	0.8	0.0	0.0
linearis	0.0	0.4	1.9	1.2	0.4	0.0
palea	1.2	0.8	0.0	0.0	0.0	1.3
paleacea	0.0	0.0	3.8	0.0	0.0	0.0
recta	0.0	0.0	0.0	0.0	0.0	0.0
spp	0.0	0.0	0.0	0.0	0.0	0.0

Table 7. (continued, sites 41 - 46)

Reimeria sinuata	1.6	0.0	0.0	0.0	0.0	0.0
Rhoicosphenia curvata	0.0	0.0	2.4	0.0	0.0	0.0
Surirella linearis var.const	0.0	0.4	0.0	0.0	0.0	0.0
ovata	0.0	0.8	2.4	0.8	0.0	0.0
Synedra affinis	0.0	0.0	0.0	0.0	0.0	0.0
pulchella	0.0	0.0	0.0	0.0	0.0	0.0
ulna	0.8	0.8	0.9	1.2	0.0	0.0
Miscellaneous diatoms	0.0	1.2	0.0	0.0	0.0	0.0

6.3 Sketch plans of each site

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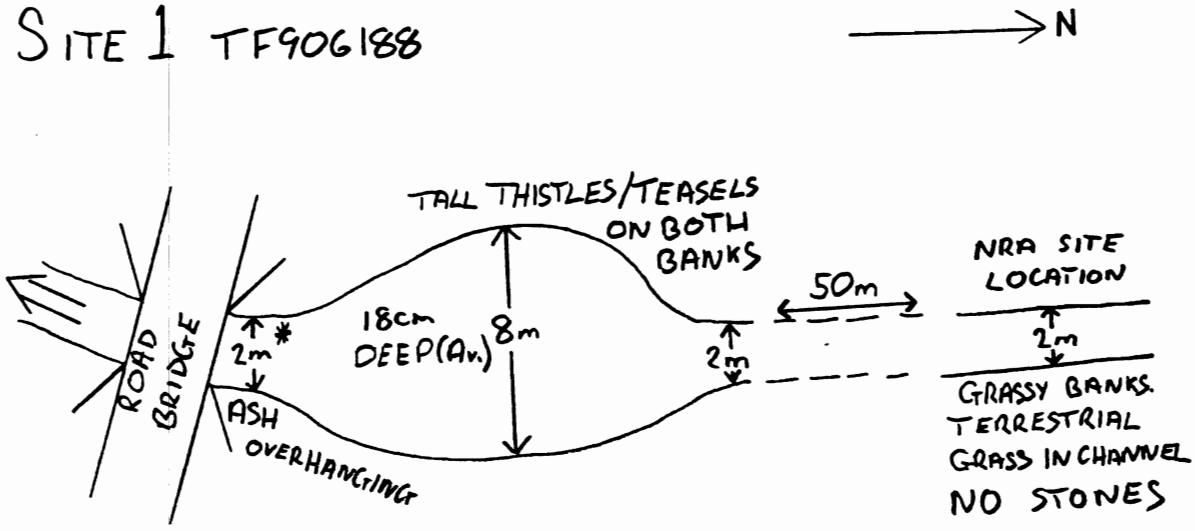

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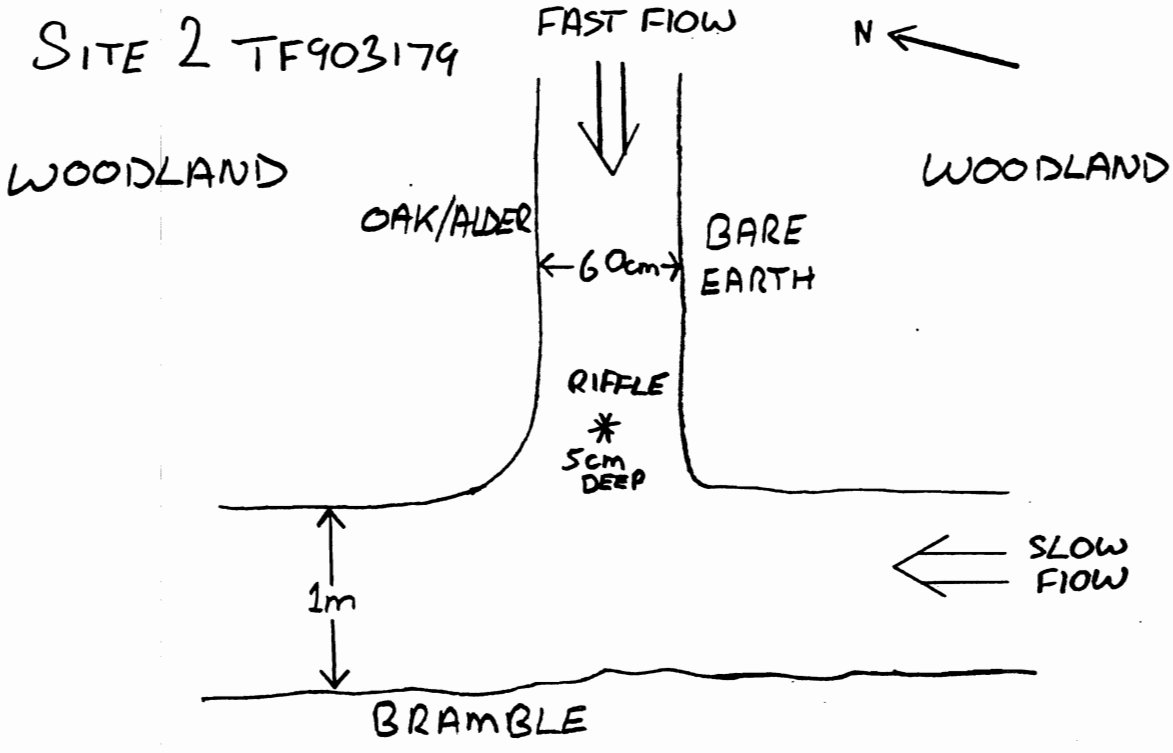

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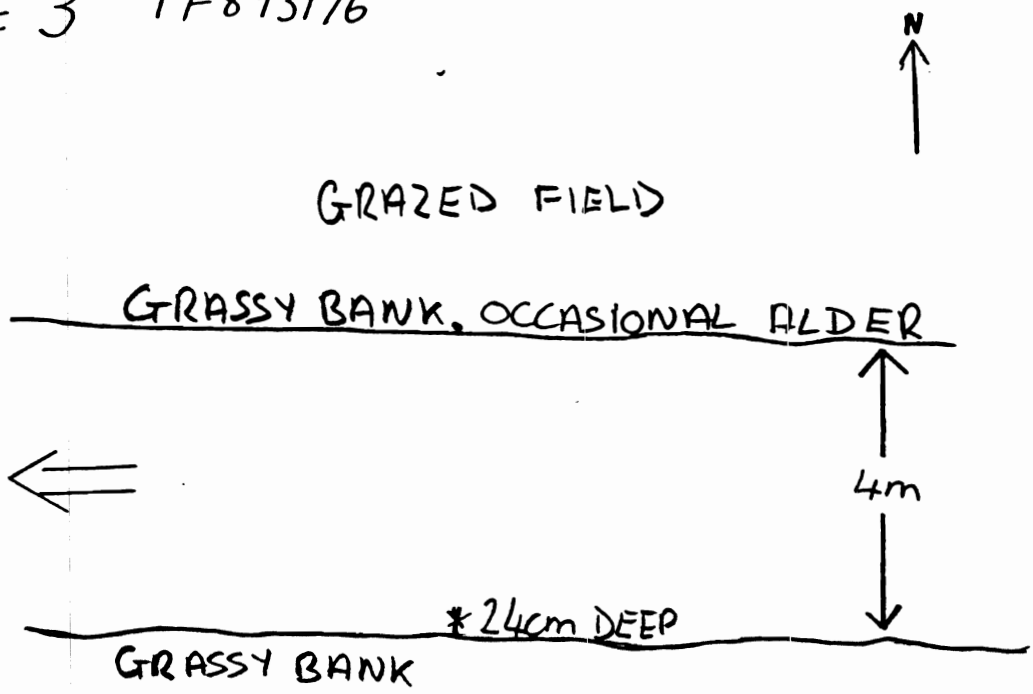

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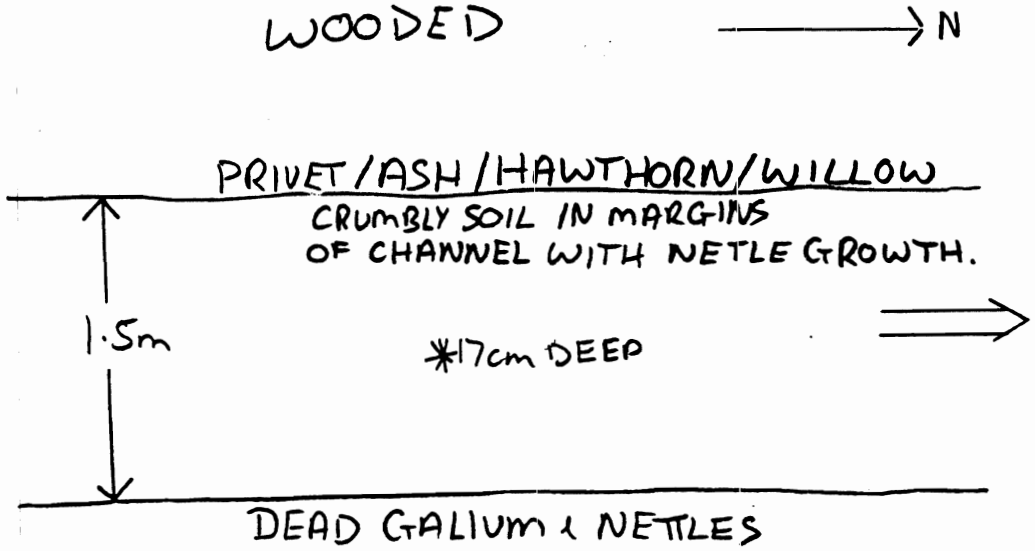

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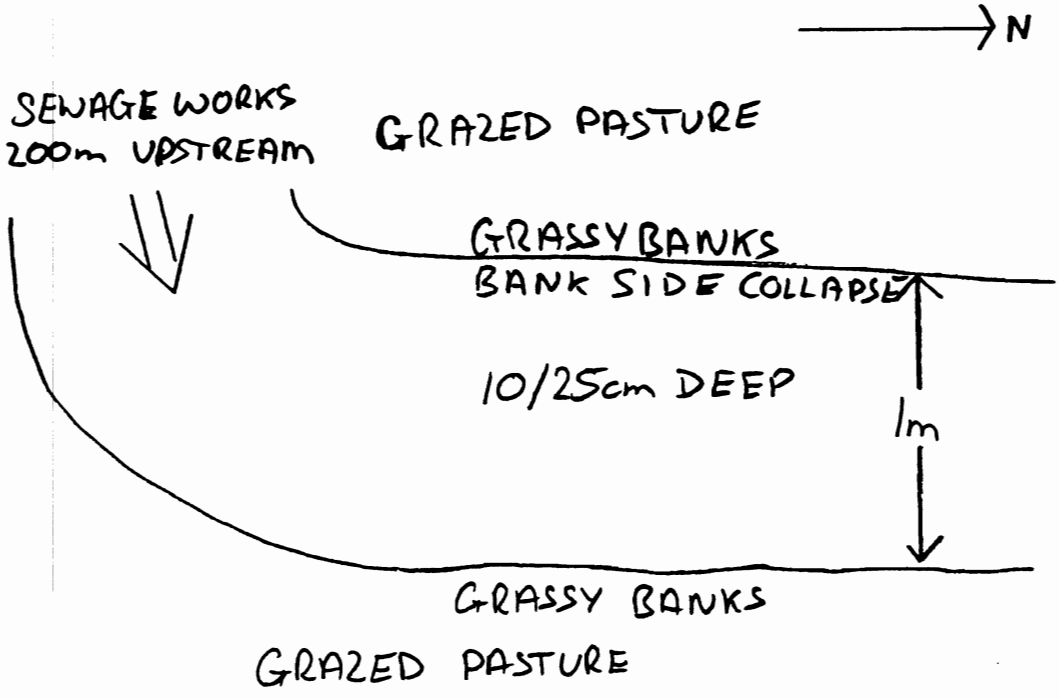

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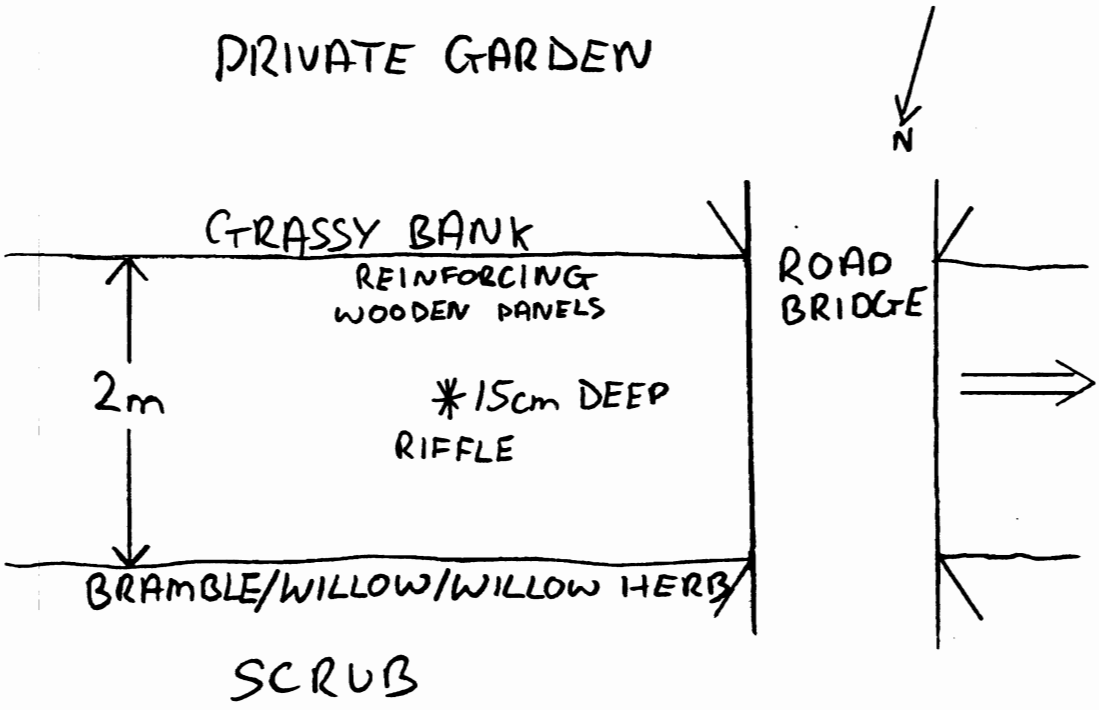

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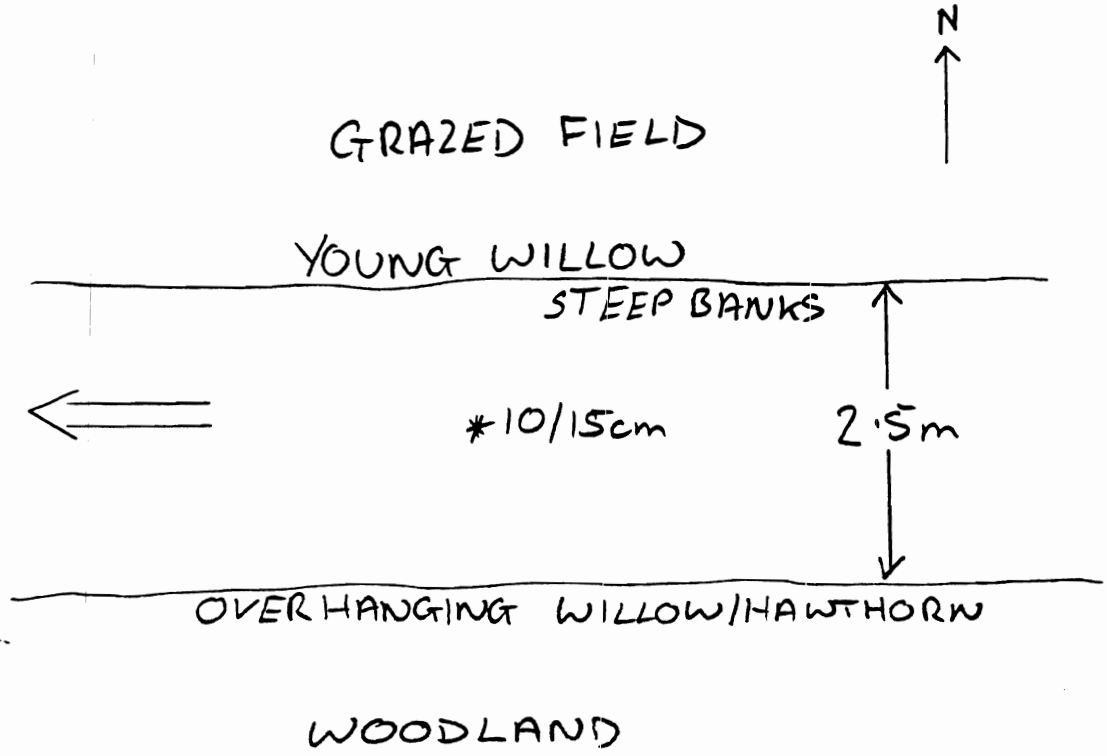

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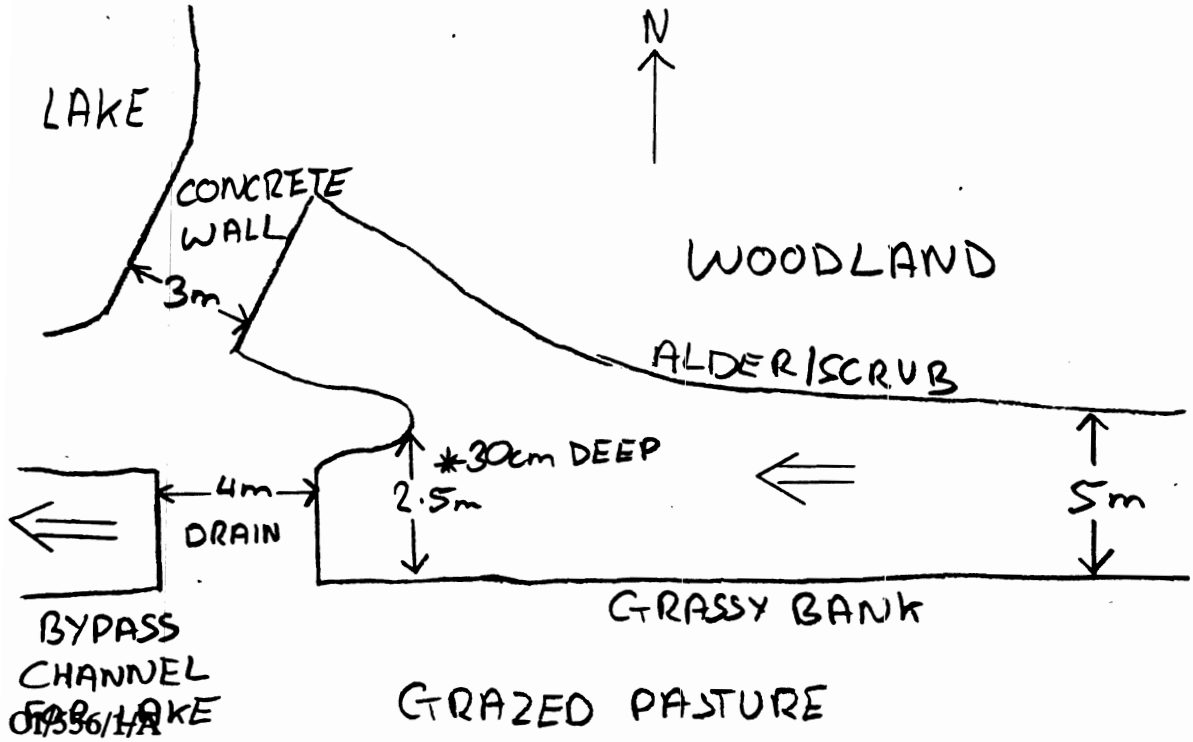

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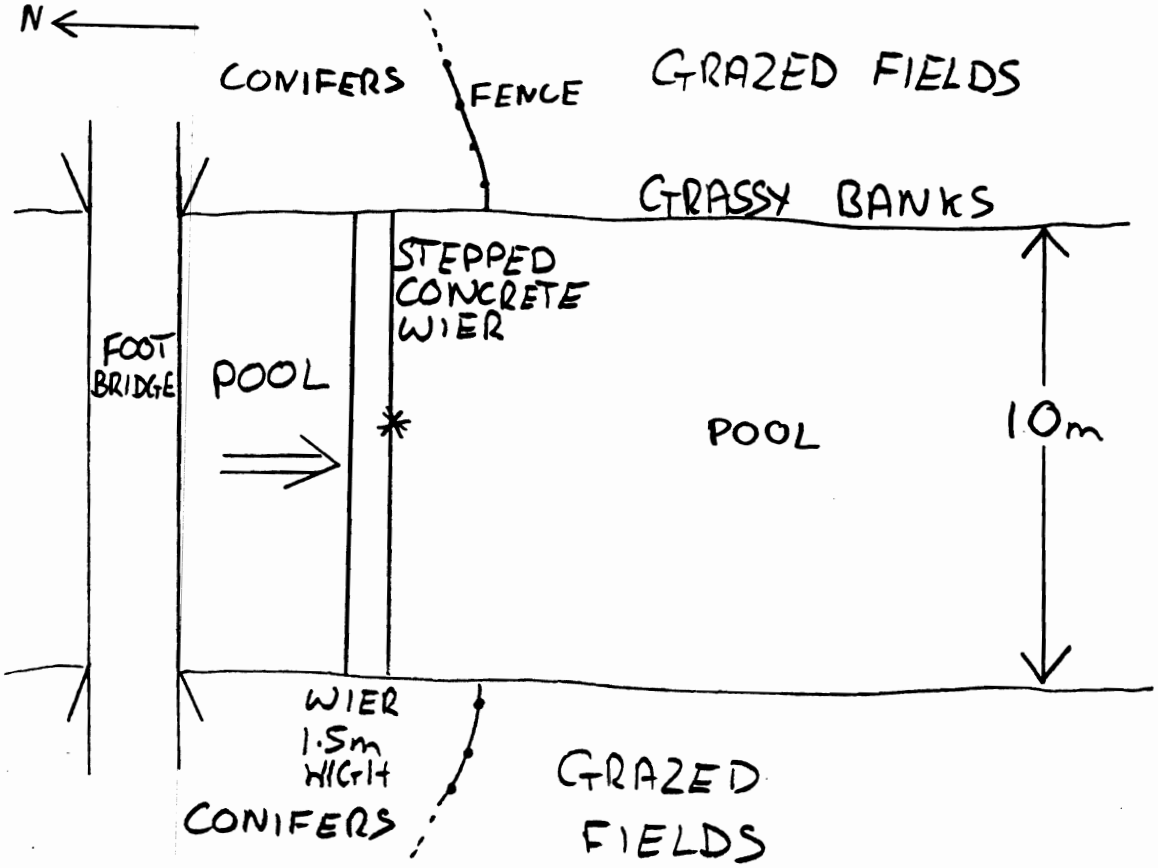

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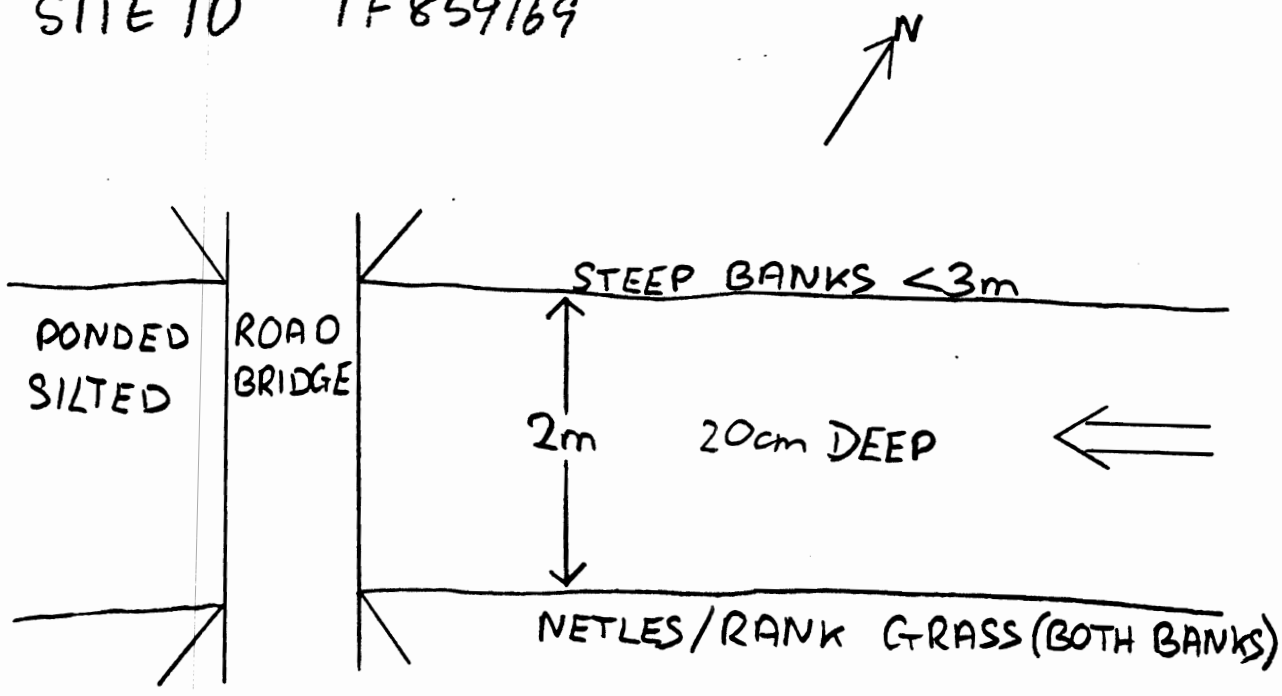

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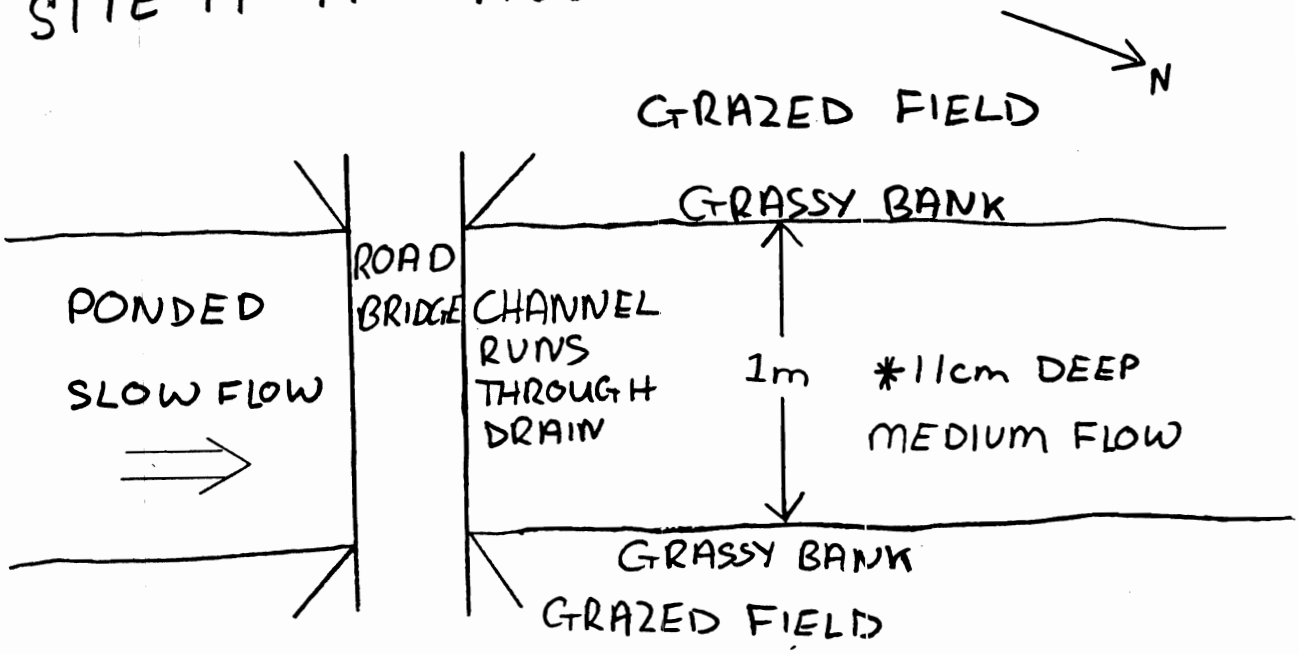

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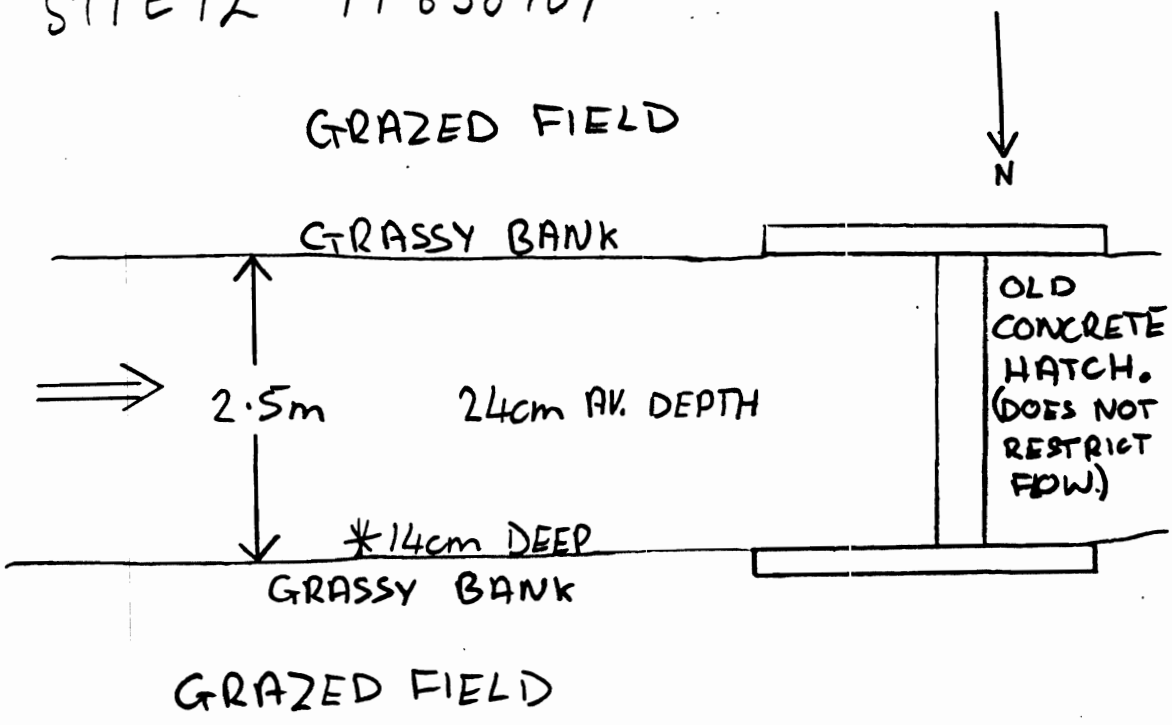

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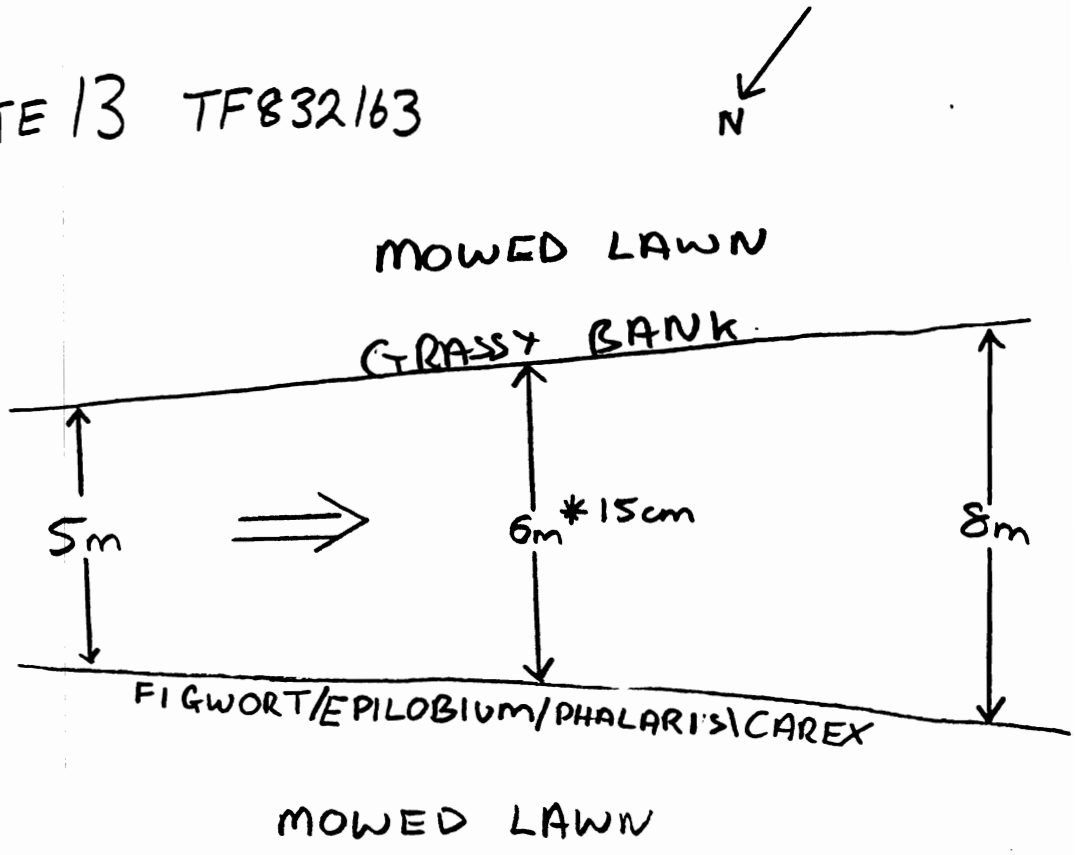

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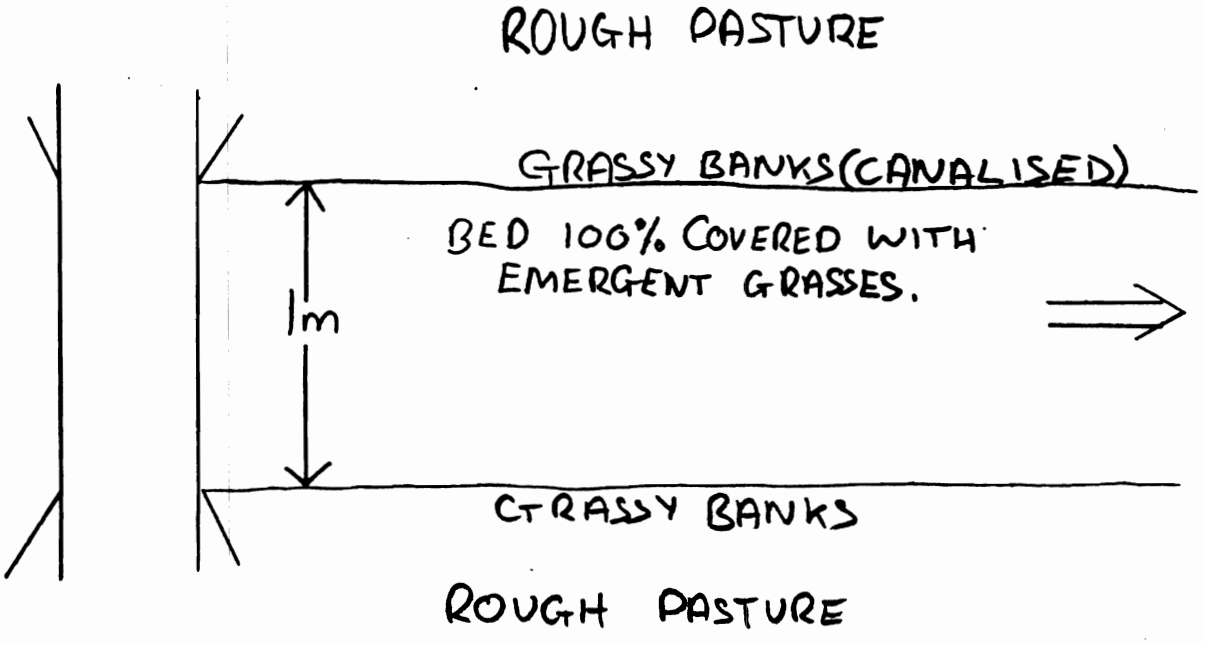

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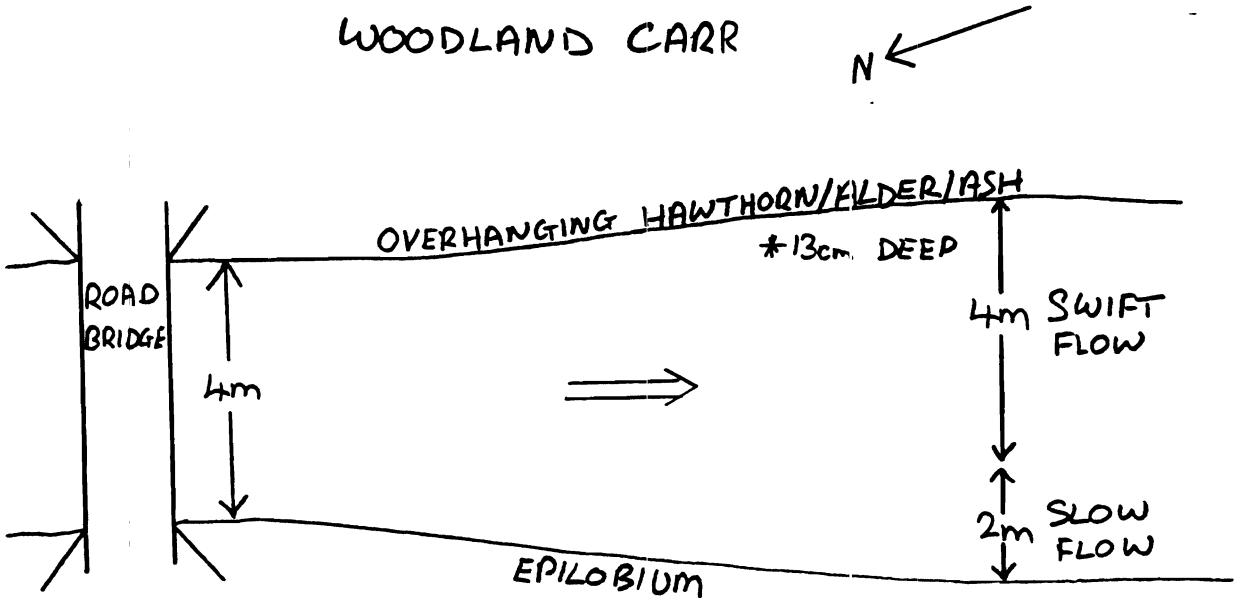

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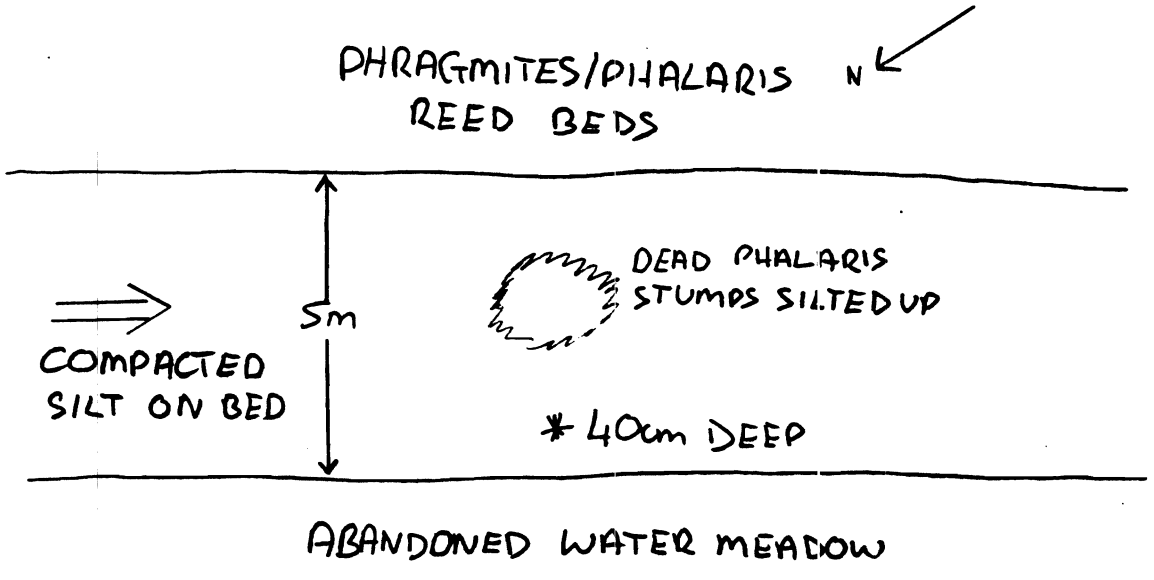

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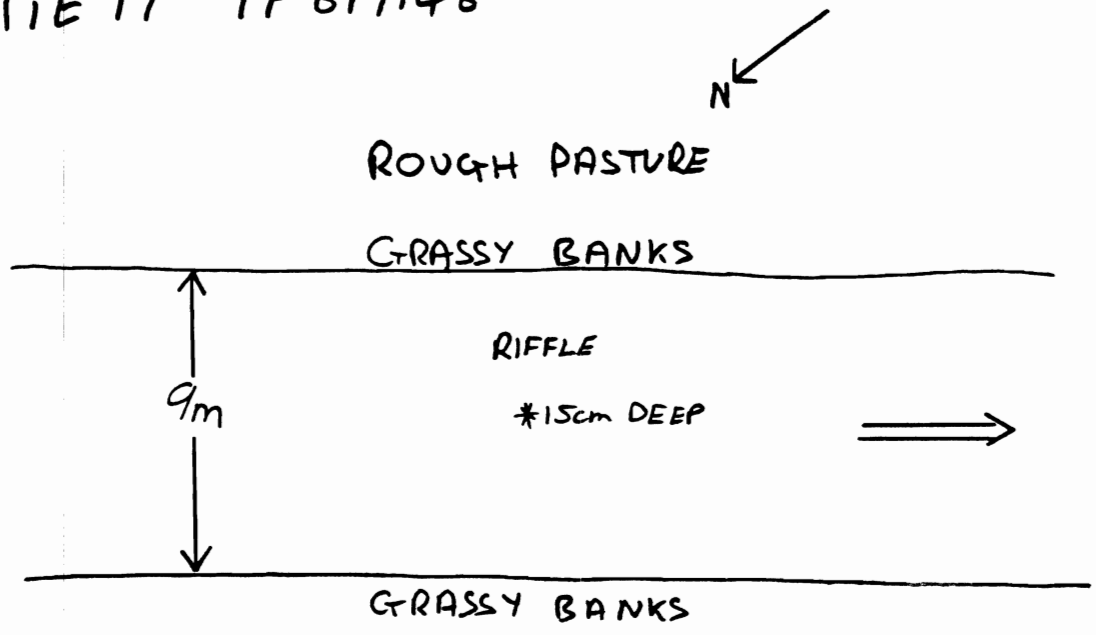

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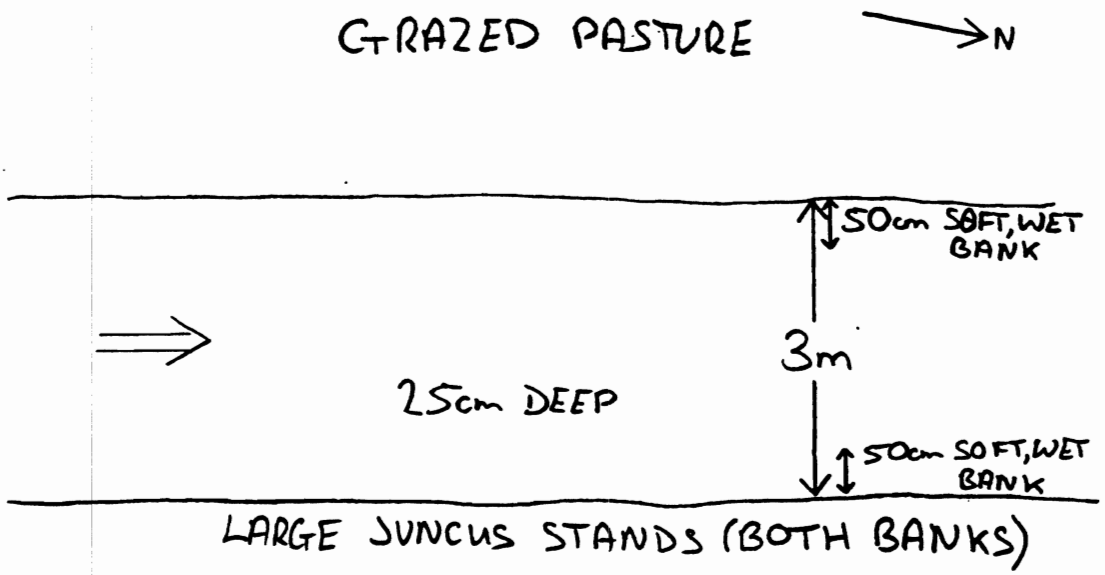

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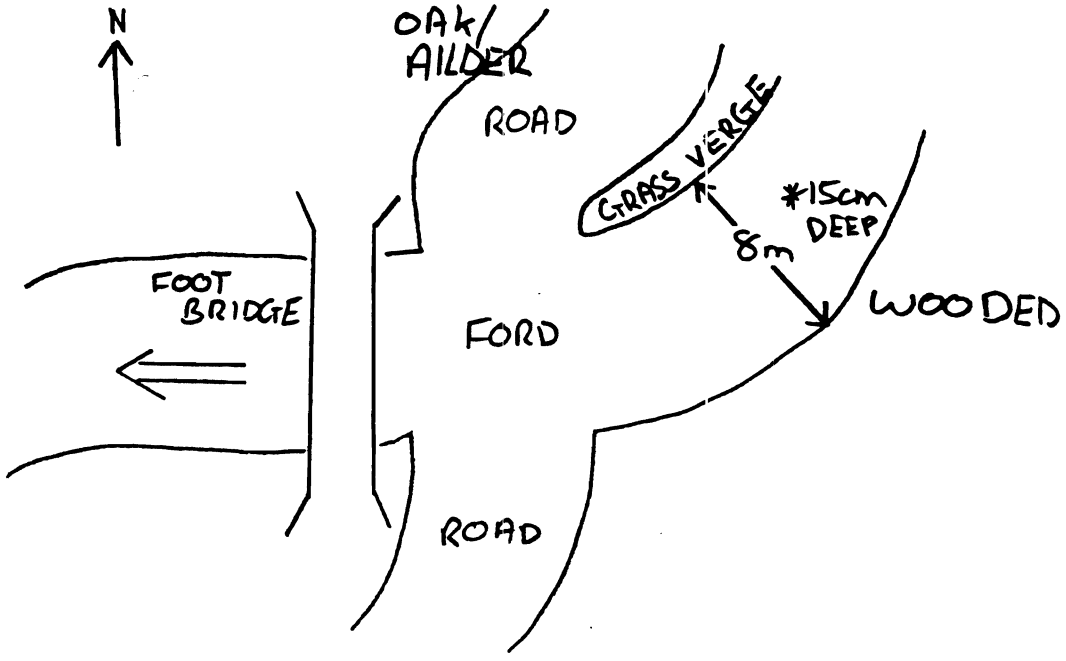

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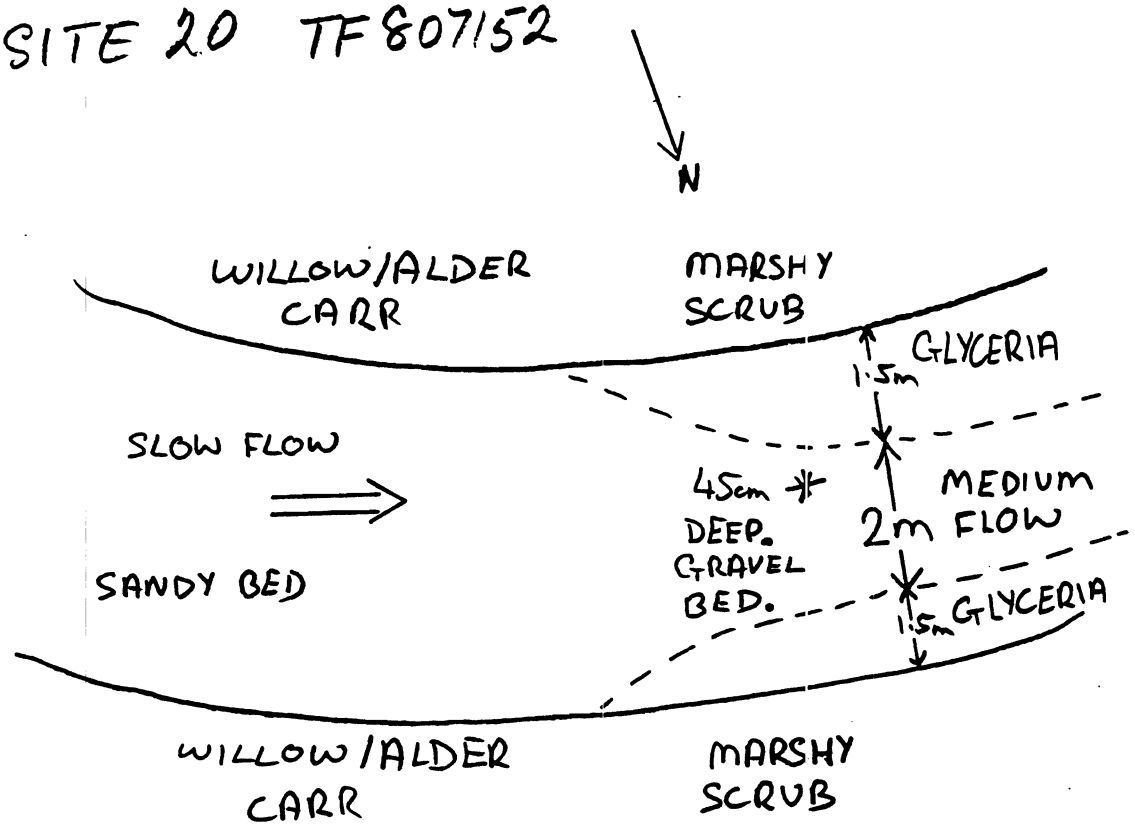

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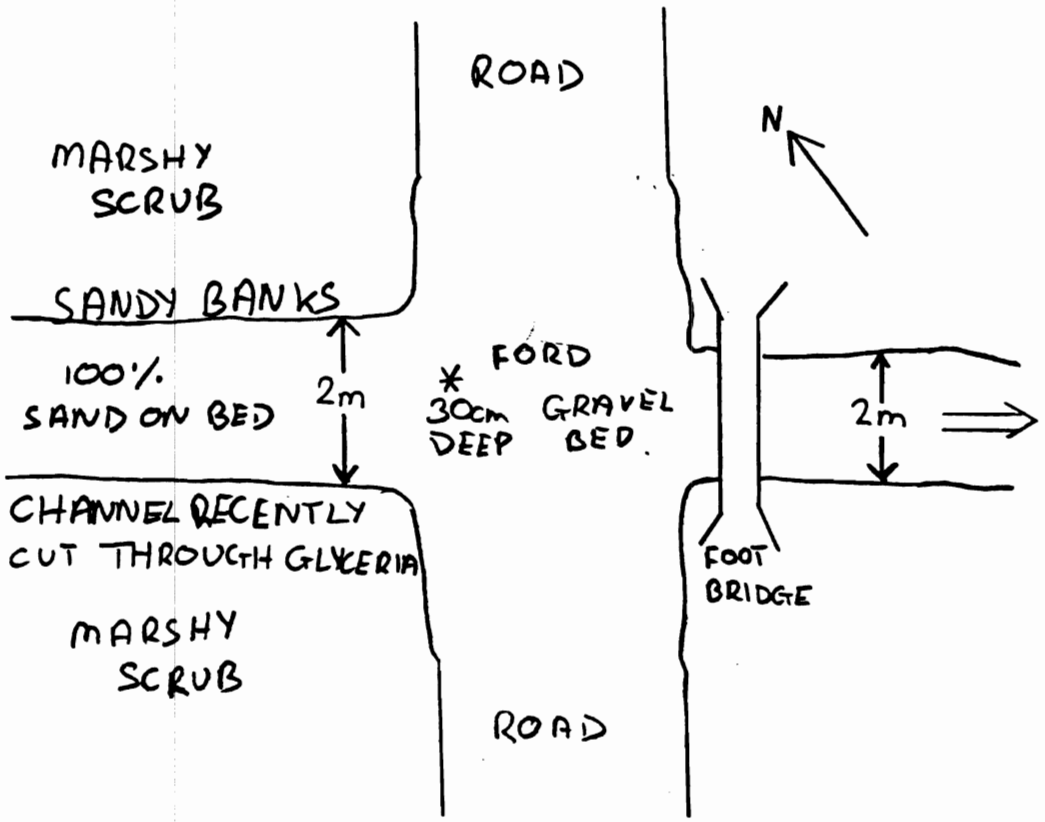

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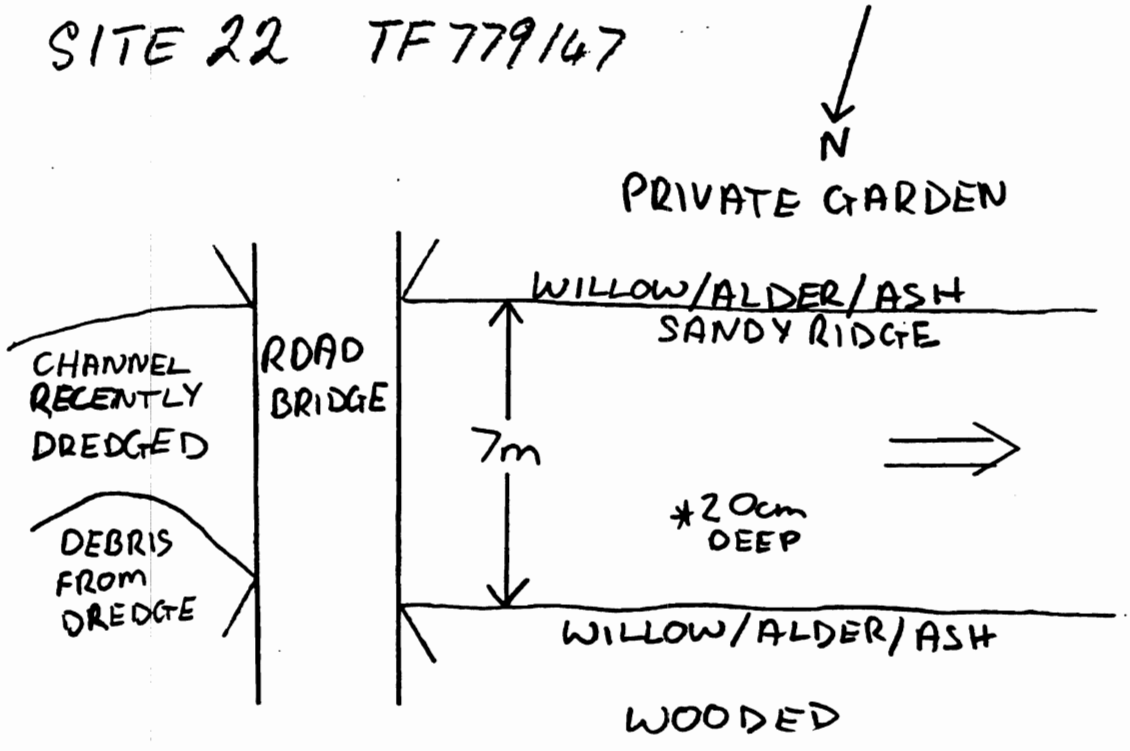

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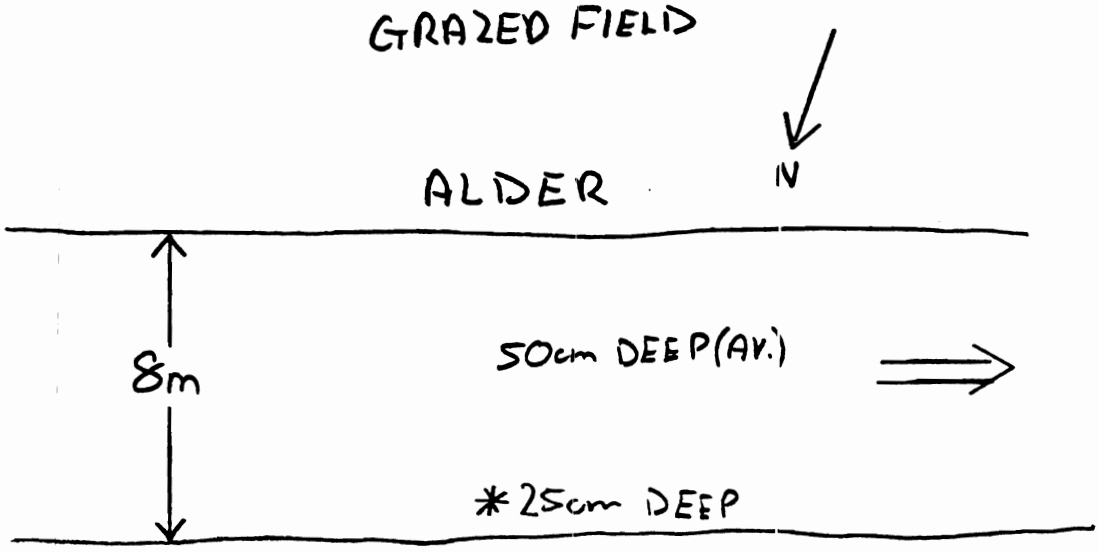

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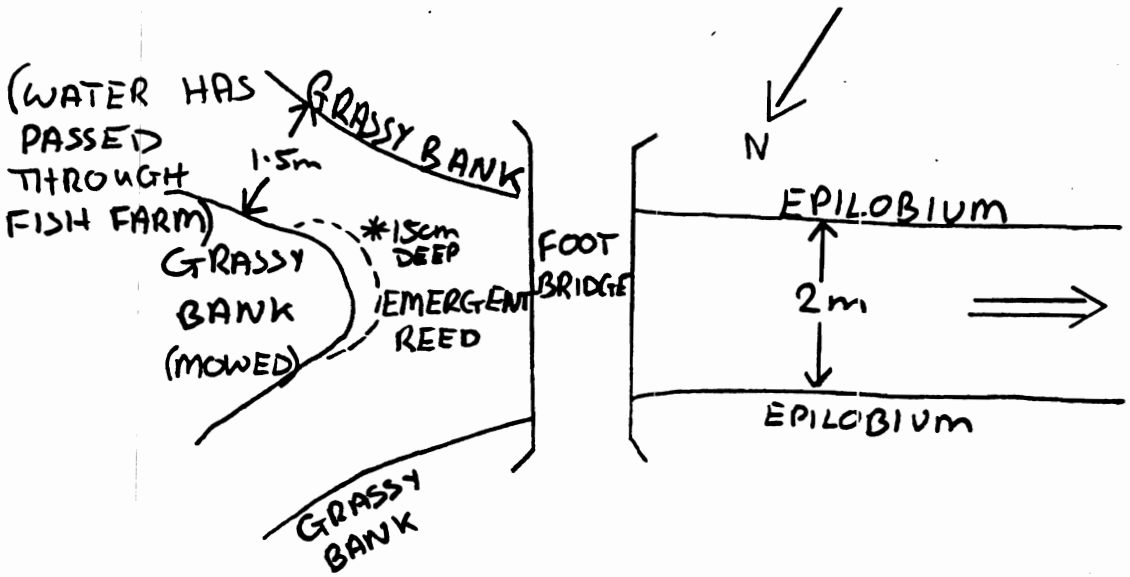

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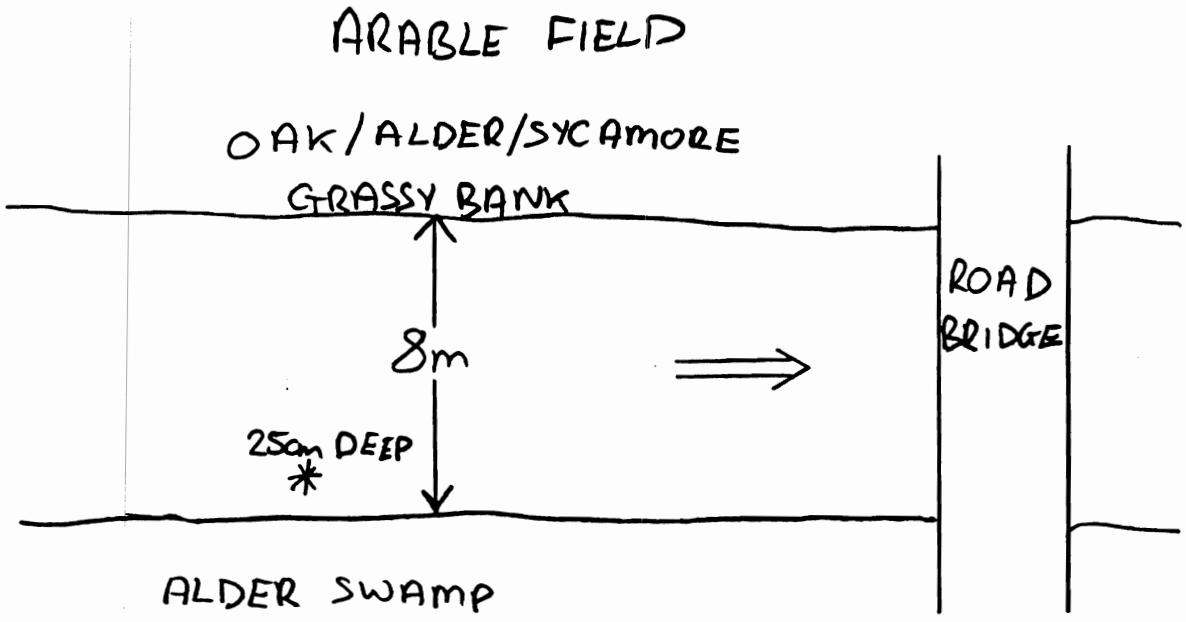

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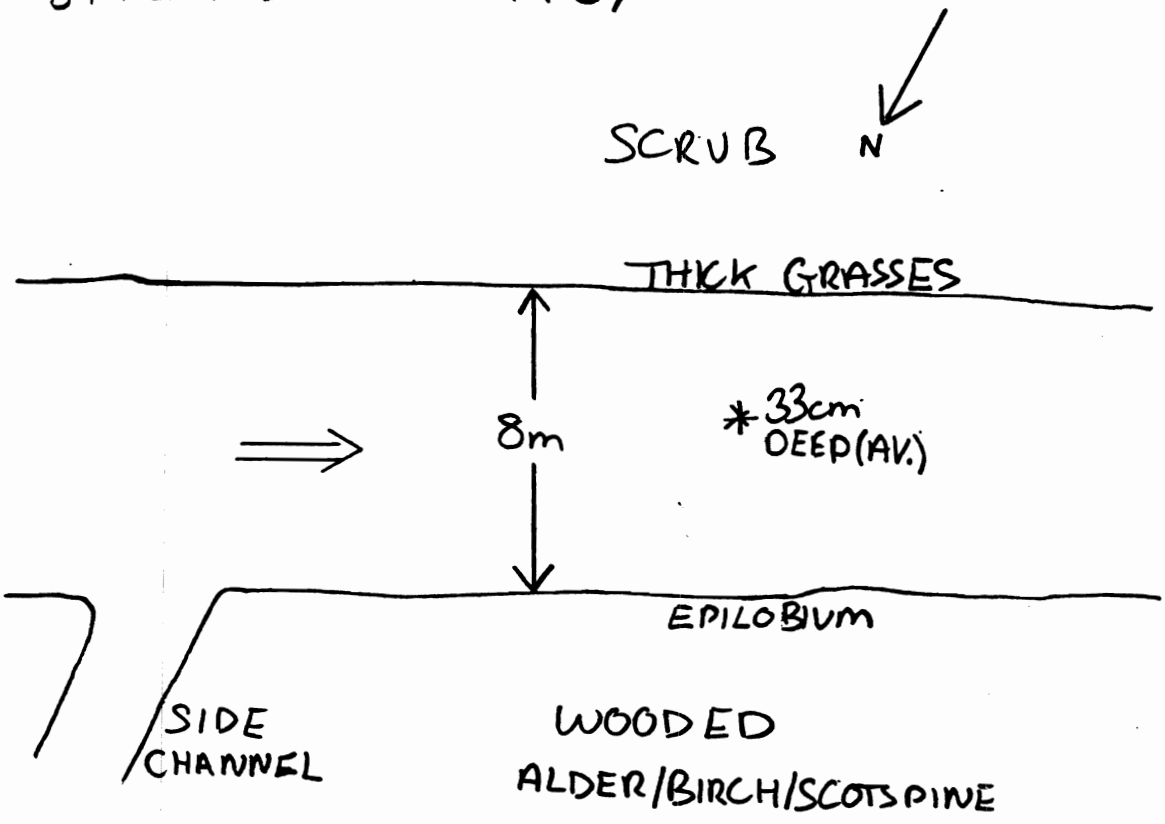

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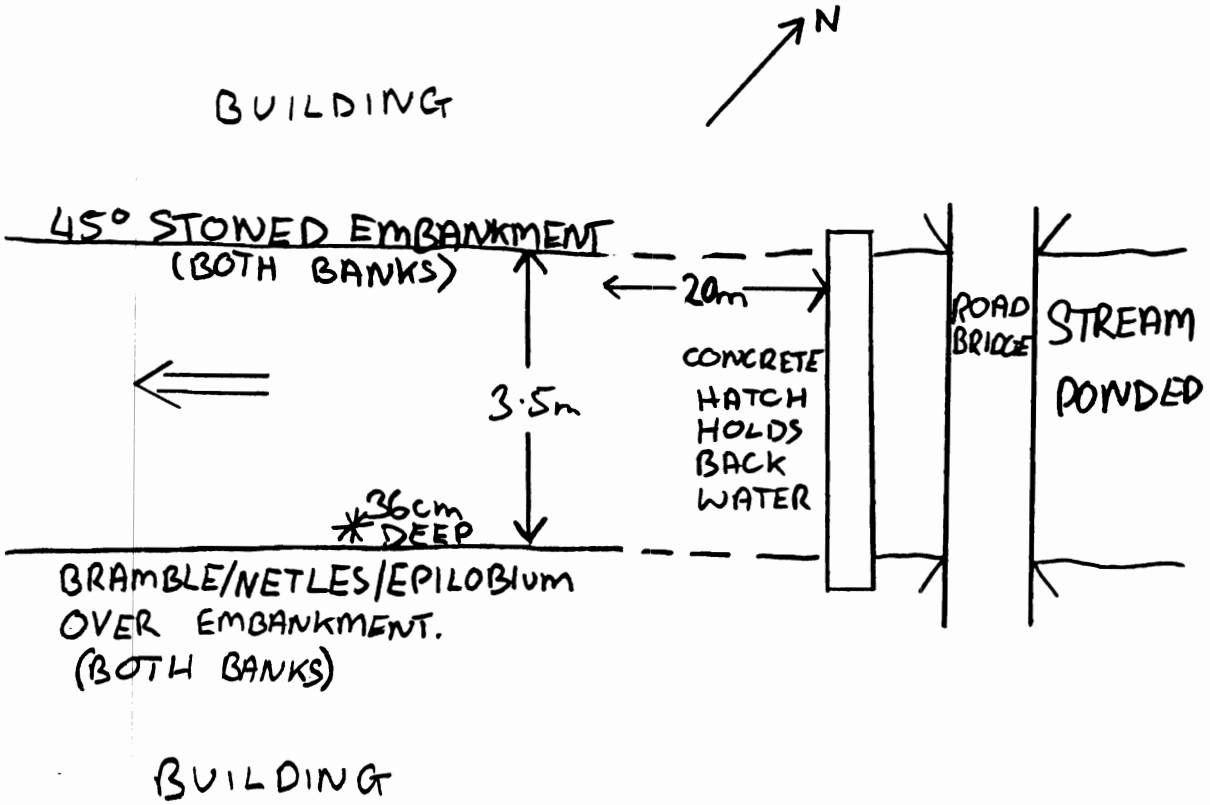

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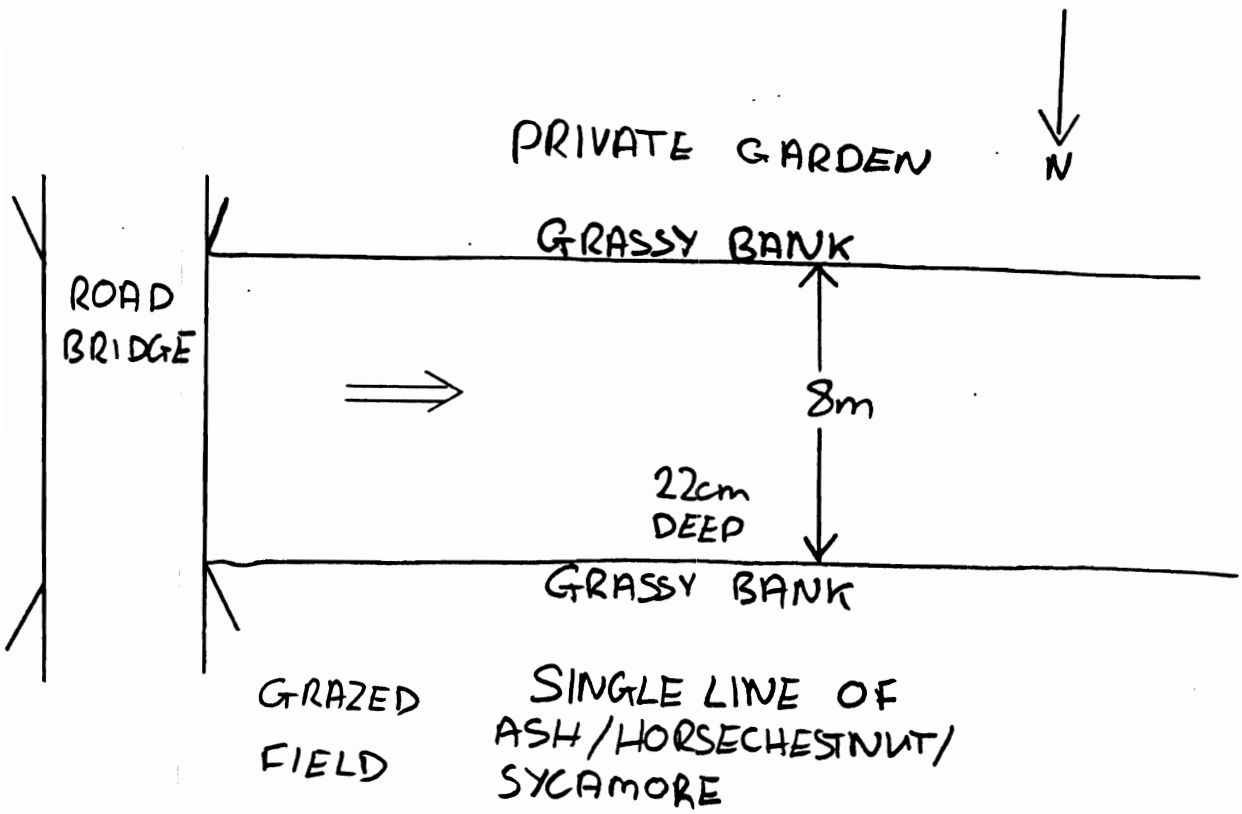

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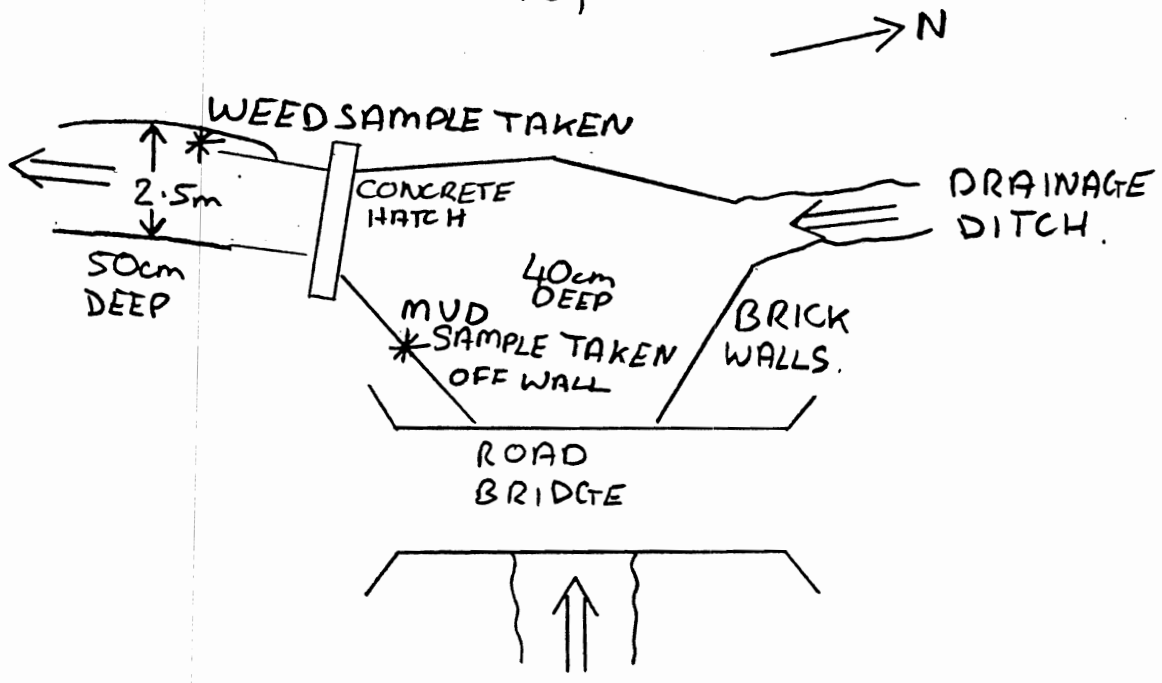

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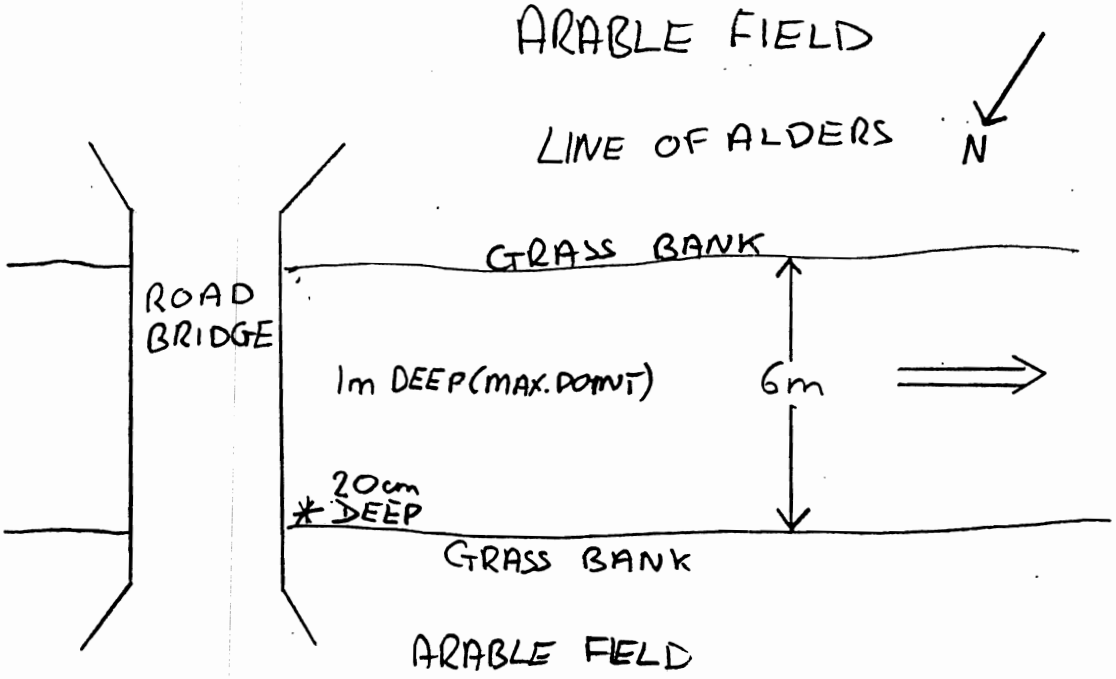

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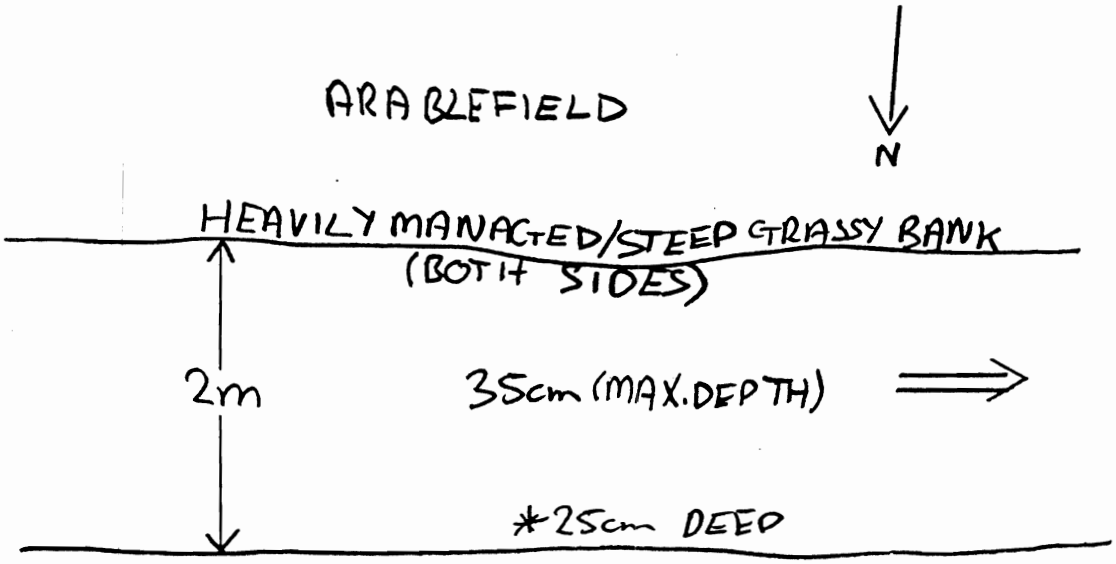

ARABLE
FIELD

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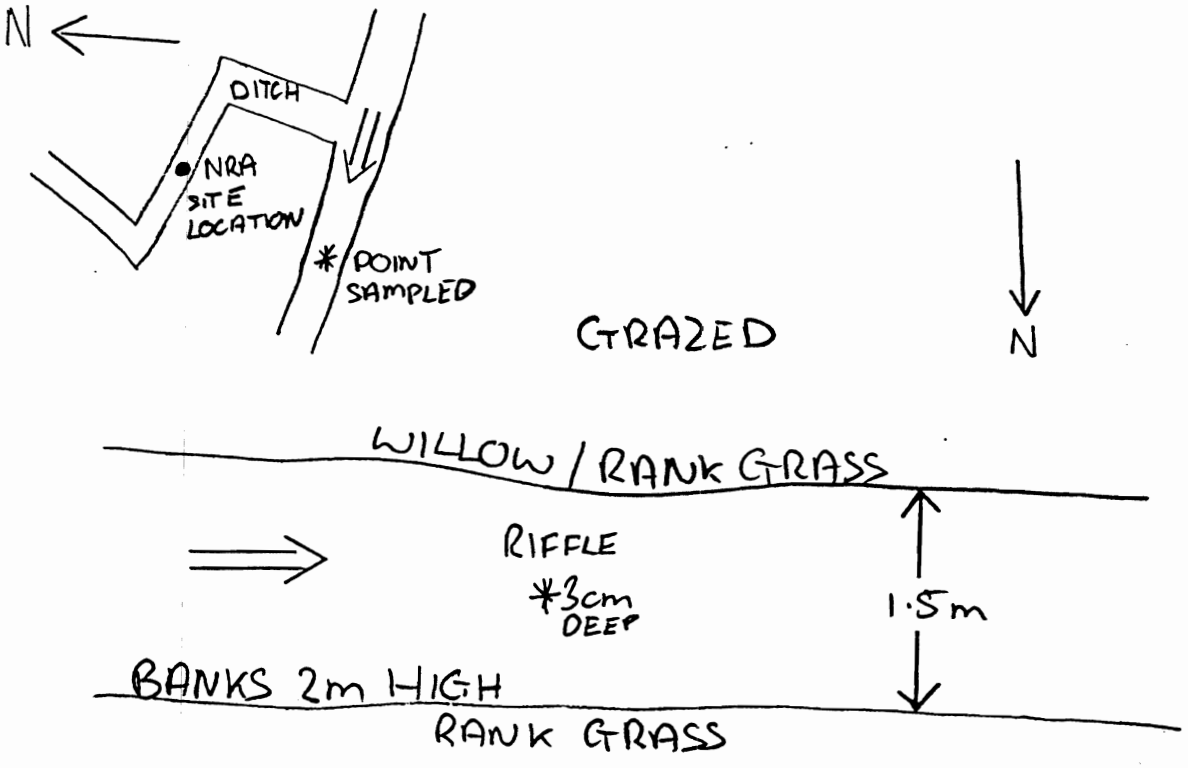

GRAZED FIELD

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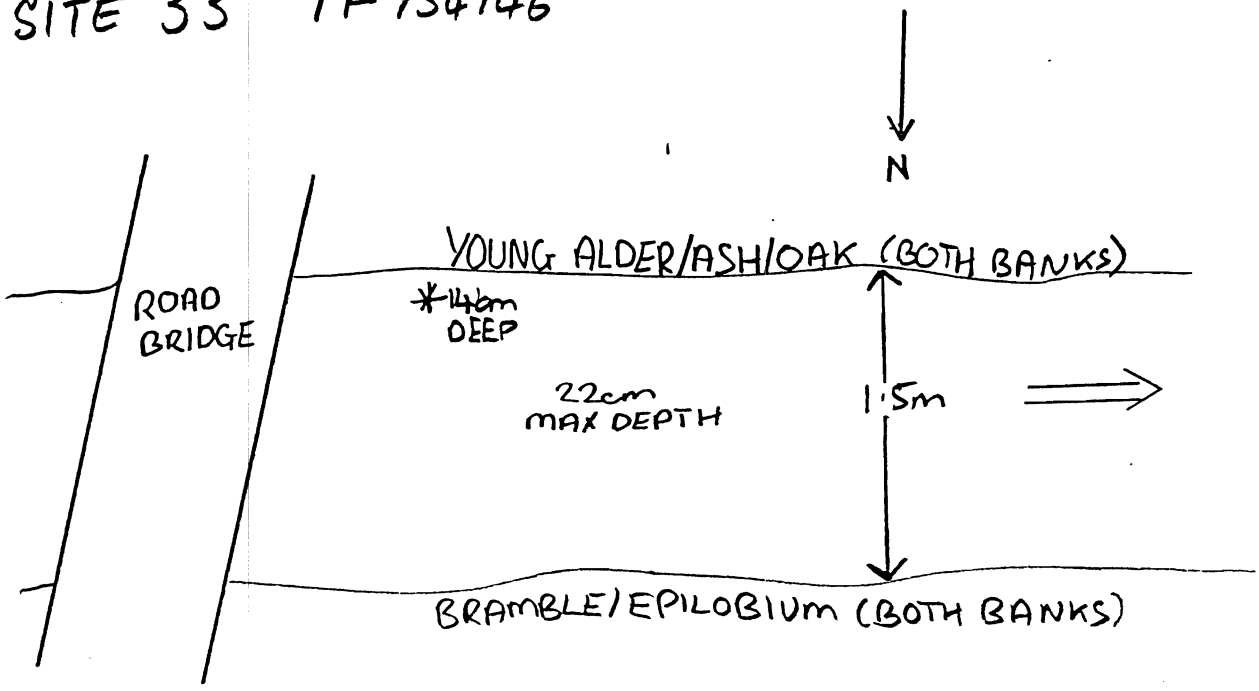

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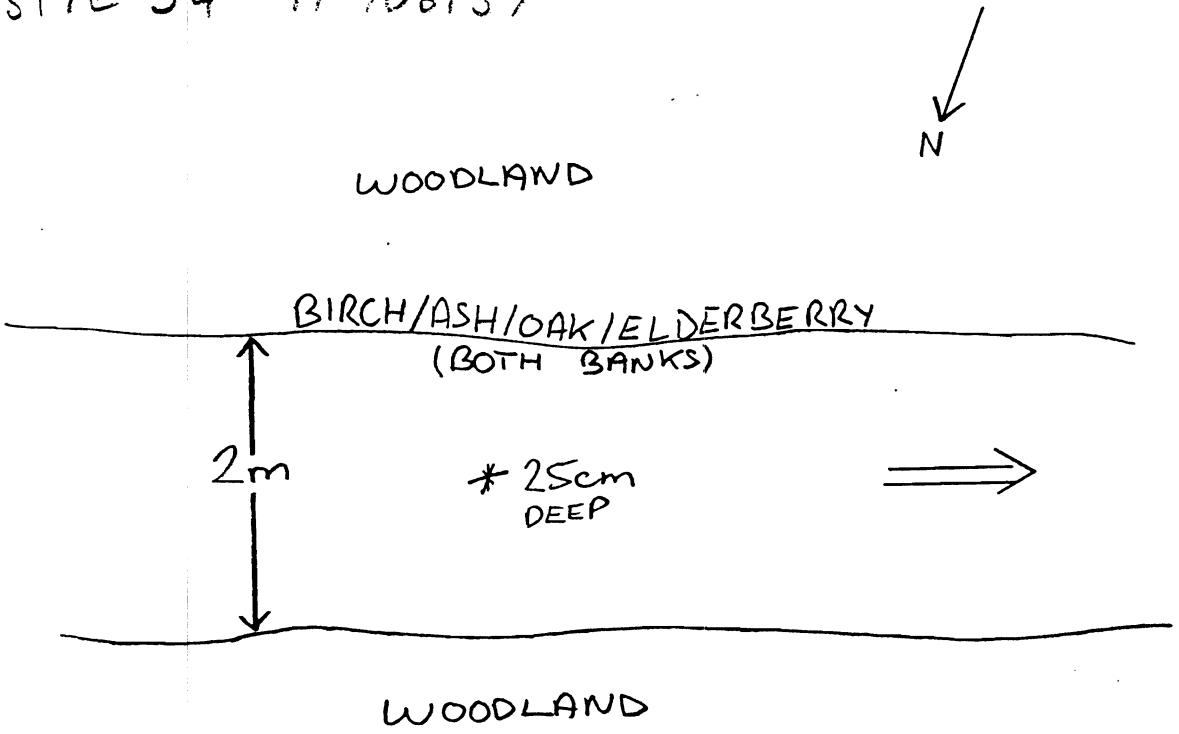

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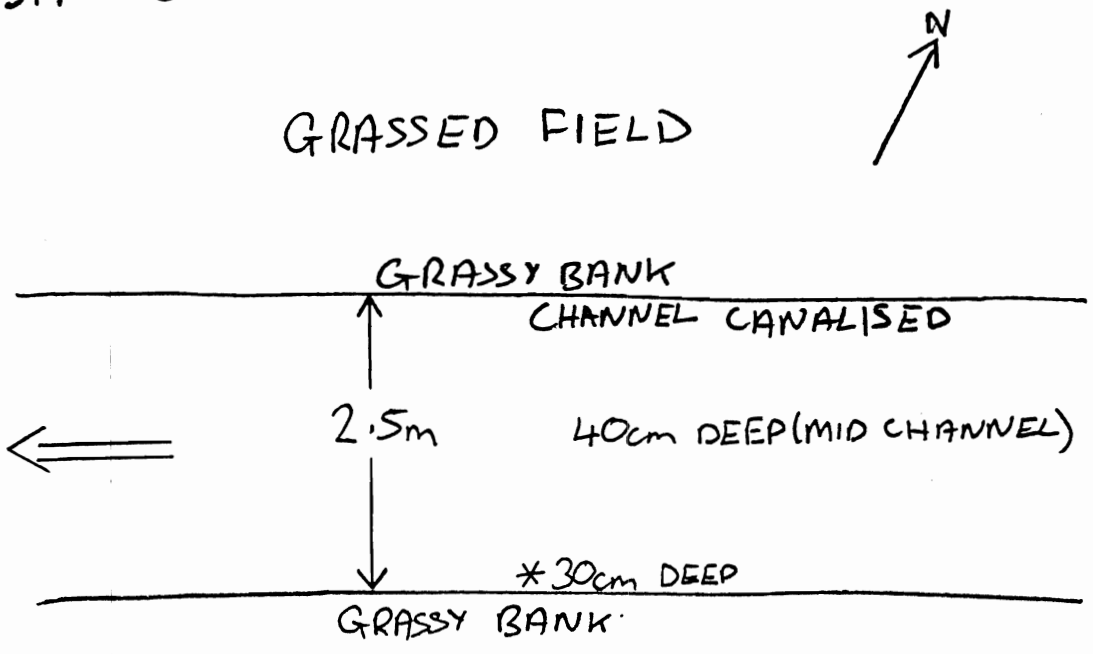

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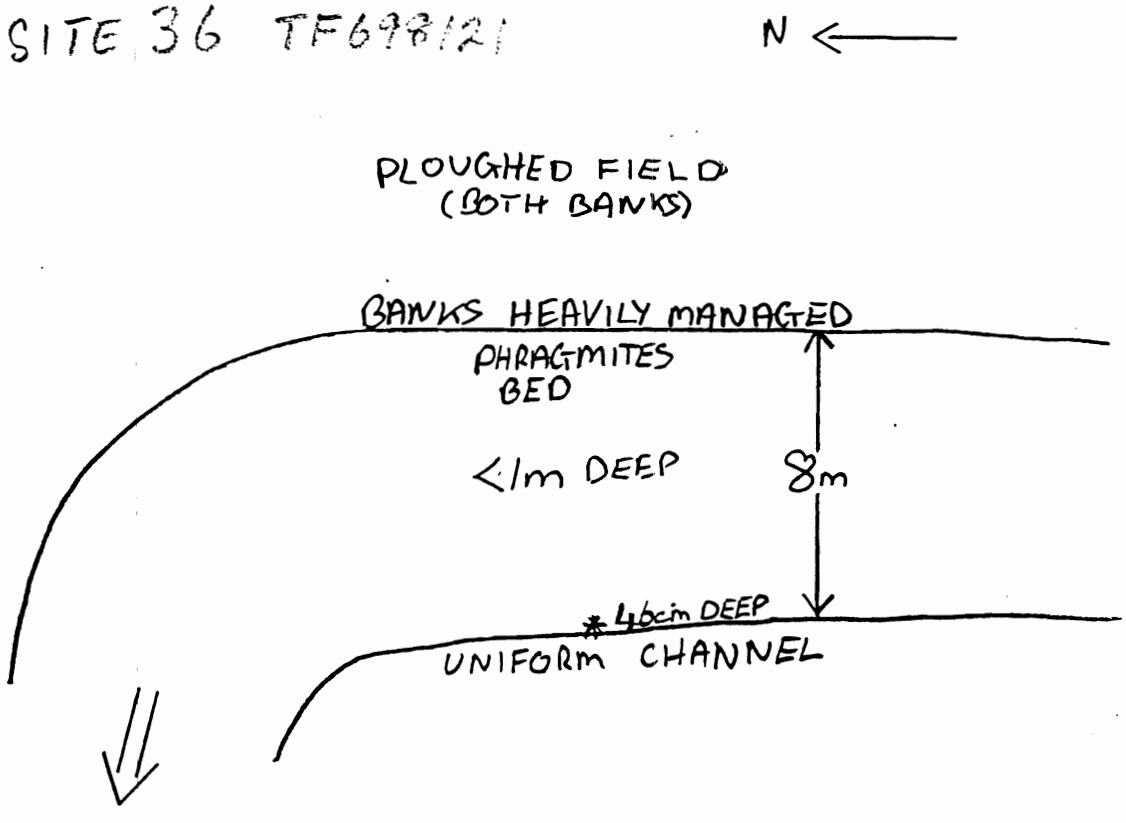

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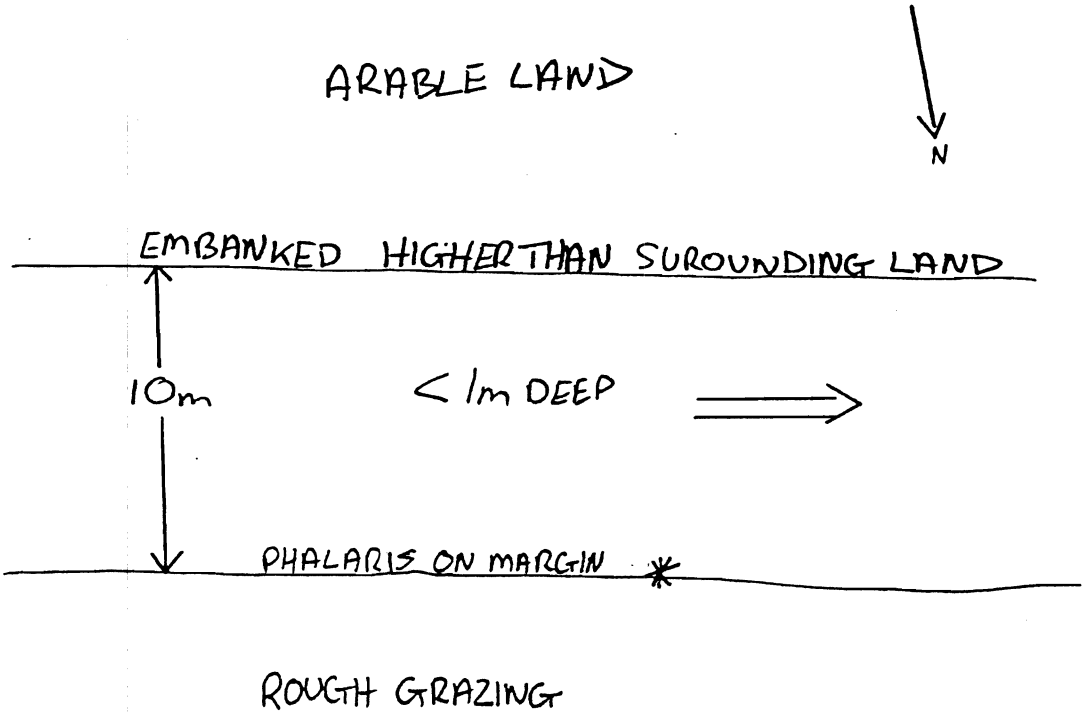

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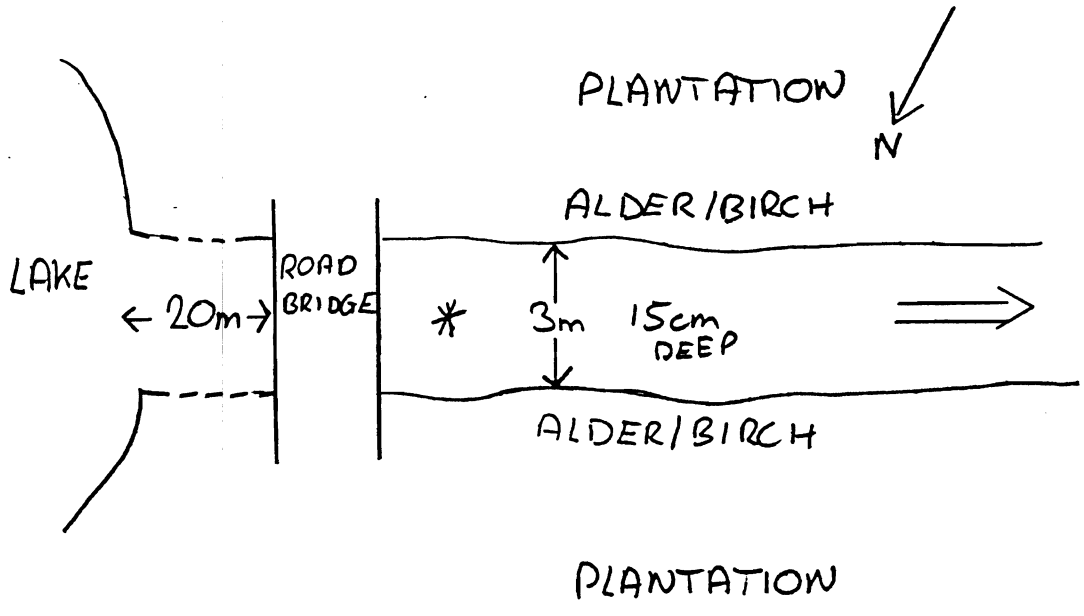

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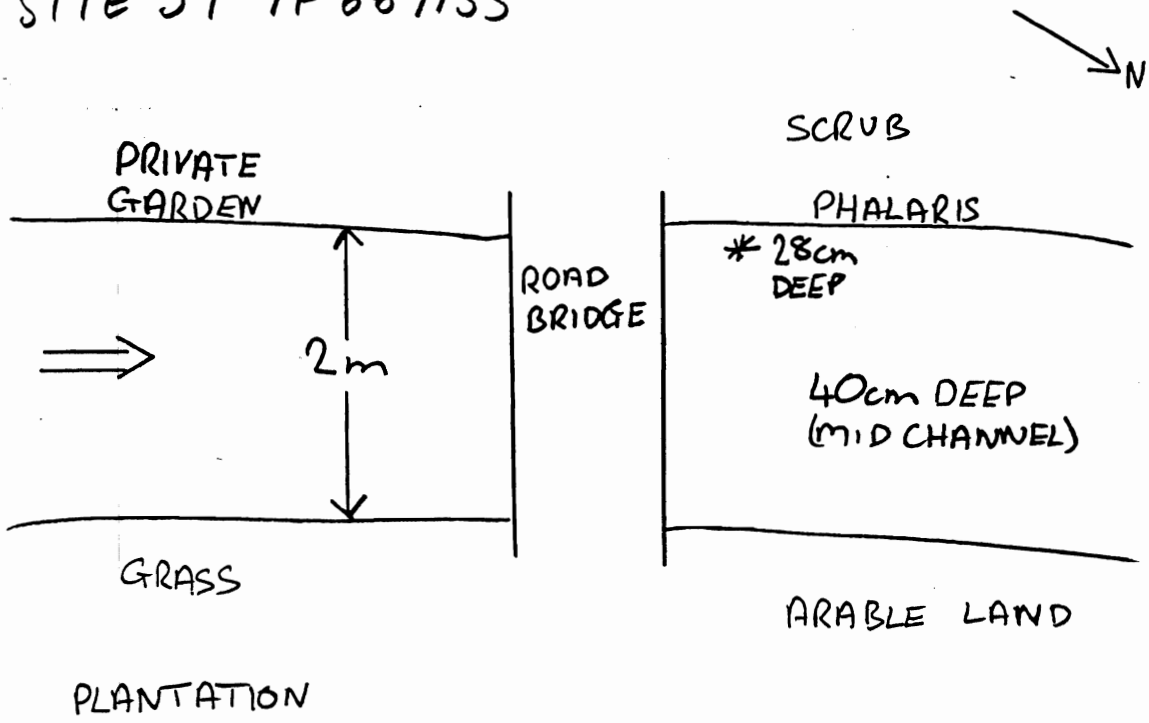

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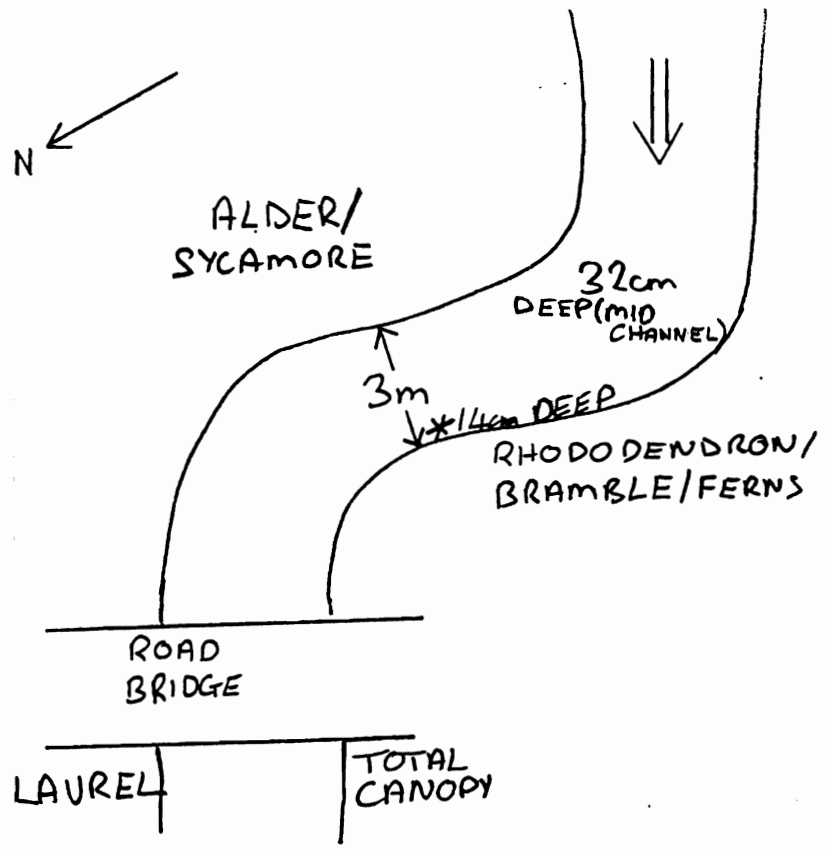

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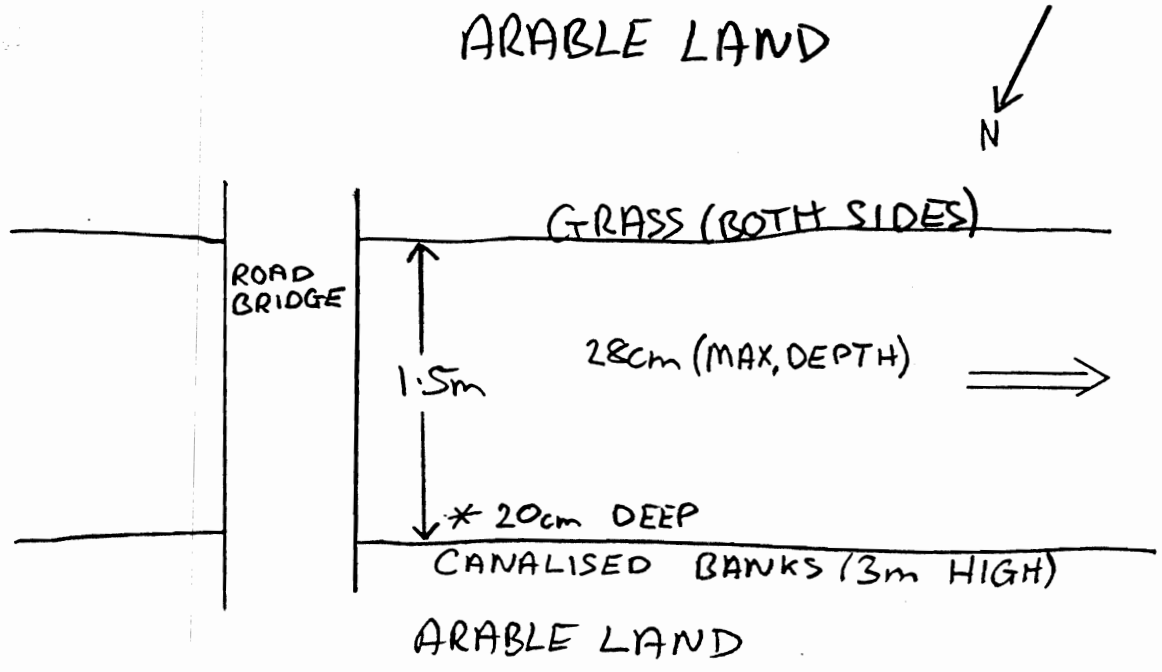

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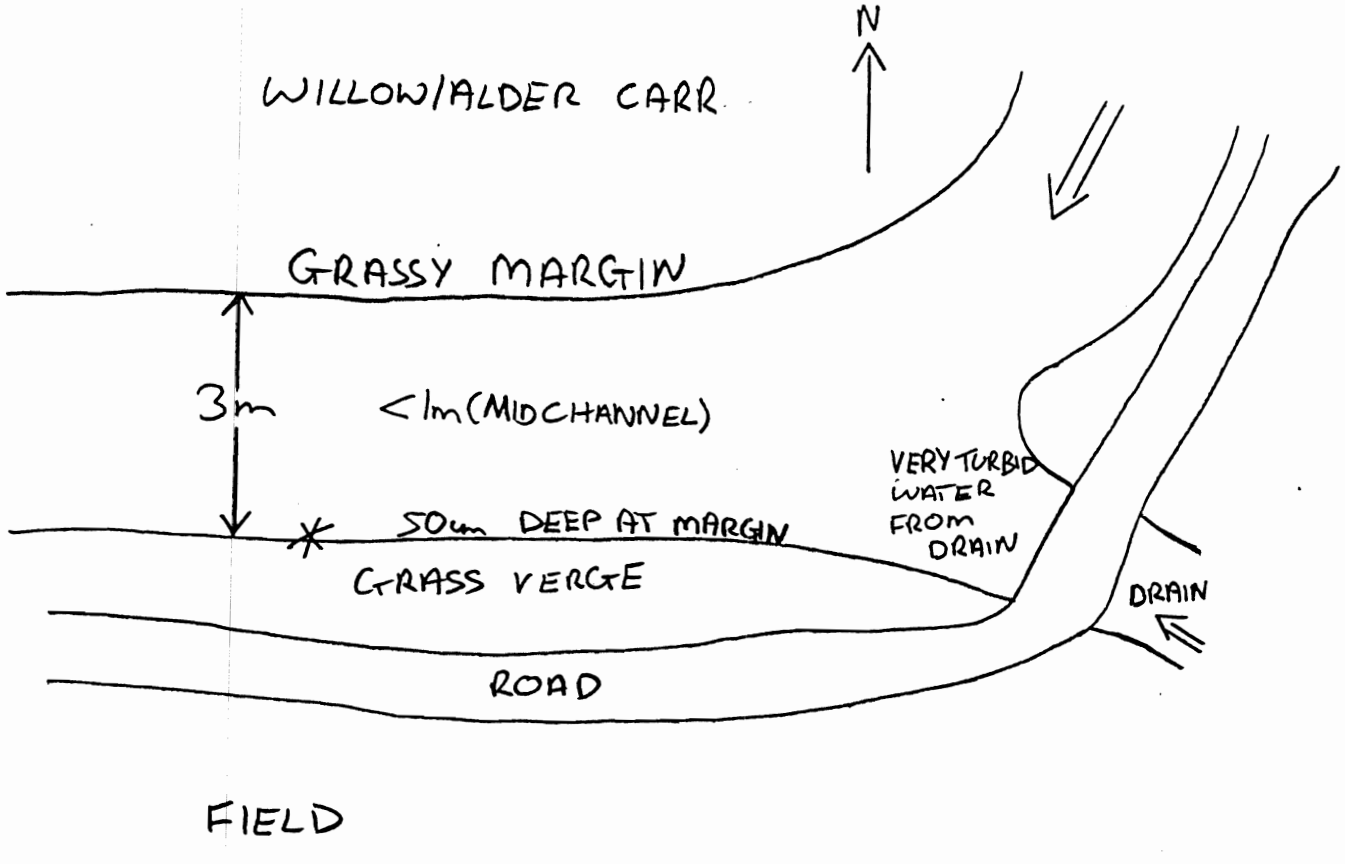

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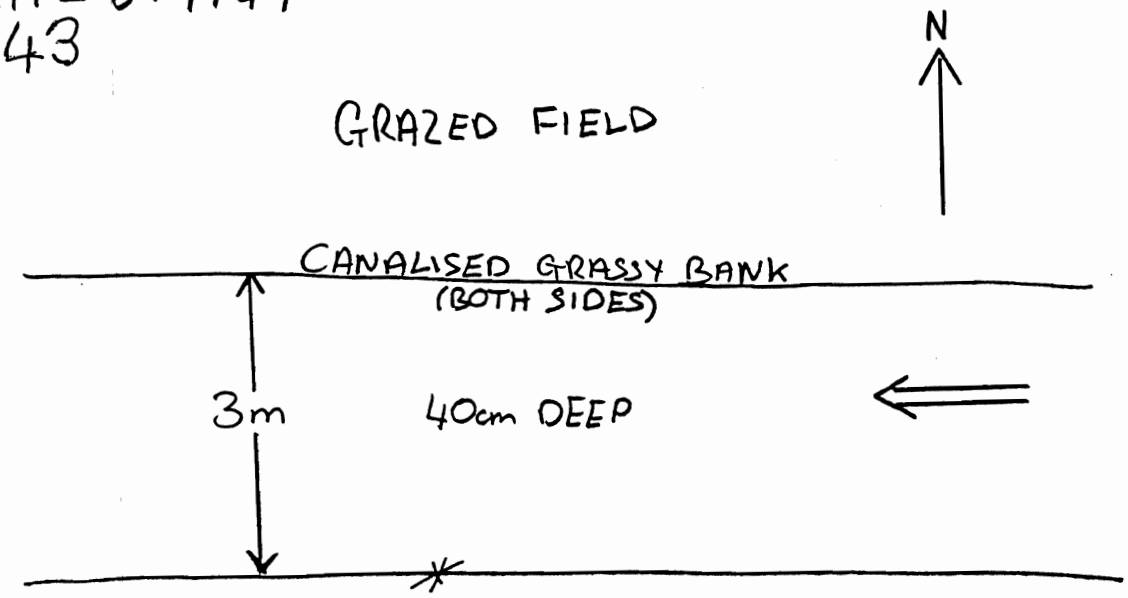
43



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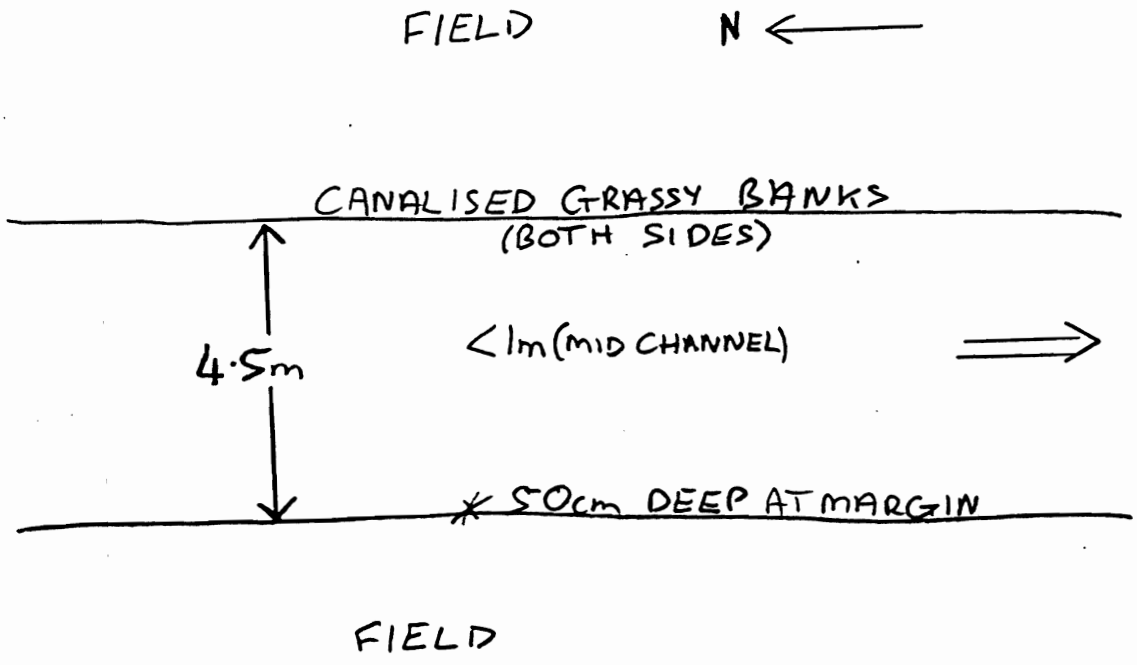

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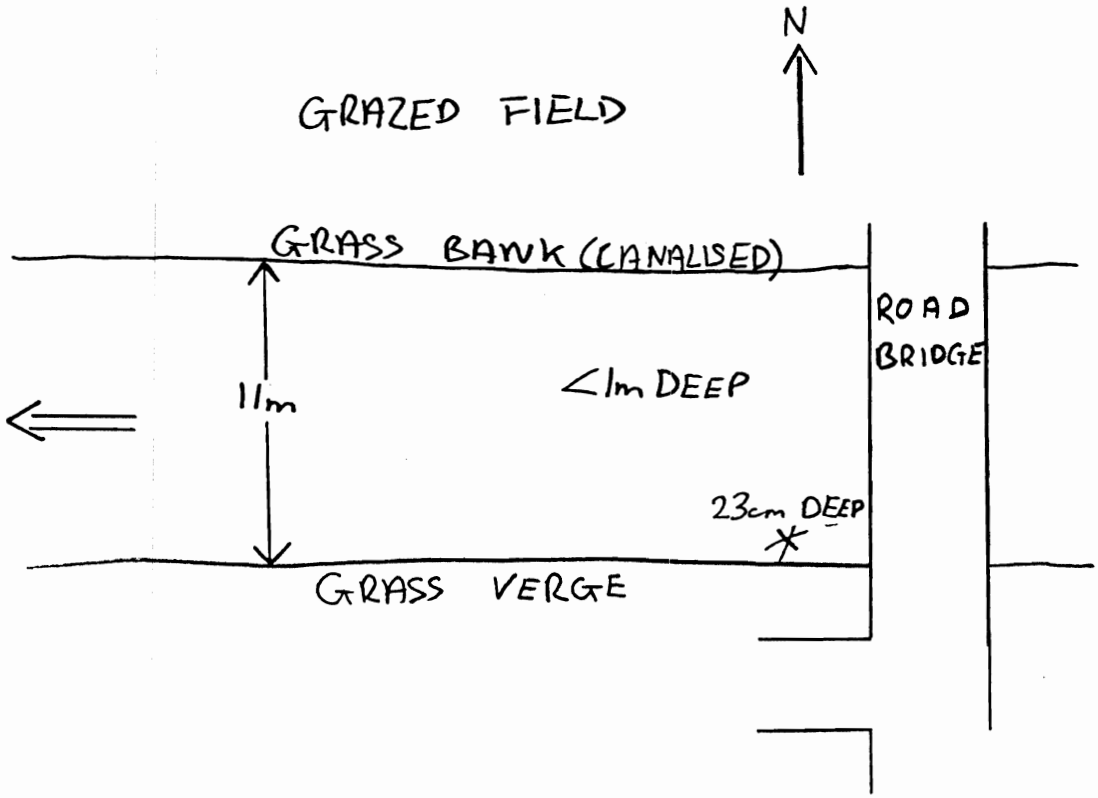

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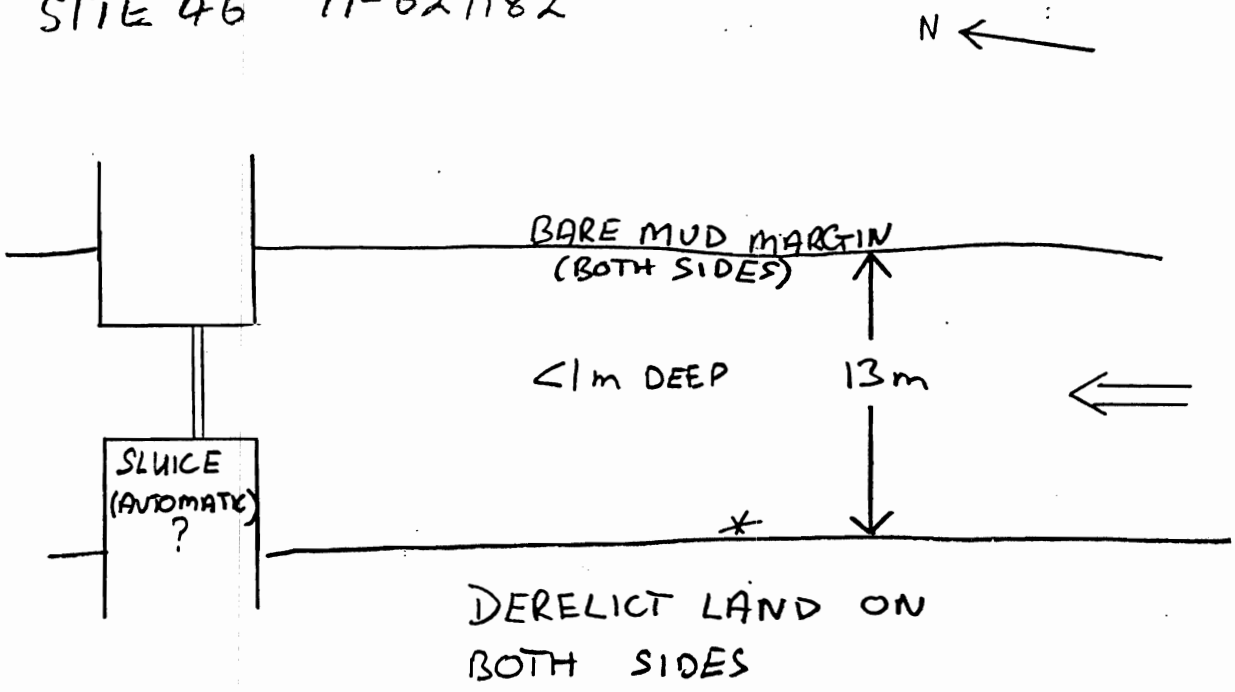

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